LTDI

IMPLEMENTING LEARNING TECHNOLOGY

Learning Technology Dissemination Initiative

Edited by Greg Stoner

with the help of other members of the 1995/96 LTDI team

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DETAILED CONTENTS

Preface

The Learning Technology Dissemination Initiative (LTDI) was established by the Scottish Higher Education Funding Council (SHEFC) in August 1994, in order to support and encourage staff throughout Scotland in the integration of technology into teaching. The project is based in the Institute for Computer Based Learning, within the Learning Technology Centre at Heriot-Watt University, Edinburgh.

LTDI has assisted academic staff in identifying curricular areas that can appropriately be supported by computer based materials, in the subsequent evaluation of possible materials, and in the practical aspects of their implementation and integration into a course.

The LTDI team consists of academic staff from a range of subject disciplines, all with direct experience of the use of technology in teaching and mostly on secondment from lecturing positions. The combination of subject knowledge and pedagogical understanding has been crucial in allowing LTDI consultants to offer advice and engage in discussions with colleagues from institutions across the country. LTDI support is available free of charge to staff within institutions funded by SHEFC.

In producing this publication we have aimed to provide a set of readings that will enhance the use of Learning Technology in teaching.

Other LTDI Activities

Implementation Support is an important aspect of LTDI activities, but is in turn supported by a range of other events and publications:

- Workshops, which include case studies and hands on access to selected packages.
- A general information service - LTDI holds copies of many relevant publications, and has a resource collection including examples of much of existing best practice in learning technology.
- Maintenance of an active World Wide Web site with links to subject specific information and resources in addition to general advice and information about technology in teaching and learning.
- An information directory (complimentary to this publication) regularly updated, briefly listing information about all TLTP projects, all CTI centres, the ITTI catalogue, and recommended reading.
- UseIT, a very practical and concise document with ideas why technology might be worth considering, and suggestions for how to get started.
- Co-ordination of e-mail special interest discussion groups e.g. assessment in the life sciences, video conferencing.
- A resource collection including examples from a wide range of TLTP, ITTI, commercial and public domain sources. In particular the resource collection includes examples of best current practice which can be used for demonstration purposes.

This publication is complementary to the LTDI Information Directory, a sister publication which contains information on the all of the projects funded by the Teaching and Learning Technology Programme (TLTP) as well as details of initiatives such as the Computers in Teaching Initiative (CTI) and the Information Technology Training Initiative (ITTI), projects and initiatives established to provide support for academic staff in the Higher Education sector in the UK. Parts of this publication and the LTDI Information Directory were previously published as the LTDI Handbook (7th Edition, December 1995). Versions of both this publication and the LTDI Information Directory are available on the World Wide Web at URL:

http://www.icbl.hw.ac.uk/ltdi/handbook/

I hope you find that this book provides interesting information, initiates thought and discussion on how best to use Learning Technology and that it proves a useful resource to support Learning Technology implementations.

Dr Roger Rist

LTDI Programme Director
July 1996.

1: Introduction

The aim

This book aims to provide material which will be helpful for those in Higher Education who wish to take advantage of the benefits that can arise by implementing Learning Technology (LT) materials into their teaching. Learning Technology, the application of technology for the enhancement of teaching, learning and assessment, offers many benefits for staff and students in Higher Education. Hopefully you will find the contents of this publication interesting and useful and that you will want to embark on a new implementation, to review your existing usage of learning technology or to plan an evaluation of the use of technology in your teaching.

This book is focused on issues concerned with **implementing** learning technology materials into the curriculum, specifically excluding issues concerned only or primarily with the development/authoring of LT materials. This focus reflects the aims of LTDI, stressing the value to be obtained from using LT materials that have already been developed. The emphasis on implementation does not imply that LT material development is unimportant. It clearly is, as without development/authoring there would be no LT materials worth implementing. However the costs (time, money and other resources) of development can be extensive and the benefits to be gained are most likely to materialise when the materials are widely used and thoughtfully implemented into the curriculum. It is, however, hoped that this book will also be of interest to developers of LT as implementation is an important aspect of LT material development.

Using 'Implementing Learning Technology': Structure and content

The chapters in this book are of various types. Some are very practical, even pragmatic, accounts of certain aspects of the use of Learning Technology in teaching. Others are more theoretical in their approach and are intended to provide a context for the more practical material and to initiate thought about the processes involved in the implementation of learning technology.

You are encouraged to 'navigate' your way around the material in this book in any way in which you see fit. In addition to the detailed contents page, and the description below of the order and content of the chapters a 'map' of the chapters is presented below to help you to decide which chapters are most relevant to your needs.

General Material	Overview of the Implementation Process	Process Stages/Details	Evaluation	Associated Topics
1: Introduction	*3: A conceptual framework*	5: Thinking about using LT		6: LT to support student study skills
2: What is learning technology?	4: Experiences and best practice of using LT	7: Choosing courseware		
		8: Practical implementation issues		
		9: Motivating students to use LT		10: Computer based assessment
			11: Conceptual introduction	
			12: practical guide / methods	
13: Where do we go from here?				
App 3: Contributors	App 1: UseIT		App 2: Evaluation Instruments	

The order of the chapters in the book broadly follows the order in which the implementation issues are likely to be addressed or encountered. Chapter 2 provides a concise survey of the various types of applications that are considered as learning technologies. Chapter 3 presents a conceptual framework of the process of learning technology integration, providing a map of the process. Many of the issues addressed in this chapter are covered in greater detail &/or from different perspectives in other chapters. Chapter 4 presents a personal view of the practical issues that arise from the use of LT and how LT might best be used within the curriculum.

Chapter 5 address several important issues related to recognising that there is a potential role for LT in teaching. Chapter 6 explores the nature of the study skills LT materials that are available and how they can be used to support students in their studies. Chapter 7 aims to help you to choose LT based course materials. Chapter 8 addresses some of the important practical issues concerned with the implementation of LT within the course curricula, concentrating on pragmatic and political issues. Chapter 9 addresses one of the most crucial aspects of the use of LT in teaching - Student Motivation. Chapter 10 details the main ways in which computers might be used in the assessment process.

The important issue of evaluation of the use of LT within a course are discussed in chapters 11 and 12. Chapter 11 provides a theoretical discussion of the nature of evaluation whilst chapter 12 provides a practical guide on how to carry out evaluations. The final chapter lists some resources that may be useful to you in the process of implementing learning technology into your teaching and evaluating the efficacy of your implementations.

In line with the different emphasis of the chapters the styles of presentation vary, consequently I have not attempted to fully standardise the styles of presentation. I have included a brief editor's introduction to one chapter (4) and references to other relevant chapters at the end of closely linked chapters.

Acknowledgement

This publication owes a great deal to the all members of the 1995/96 LTDI team, all of whom have contributed in various ways to this publication. In particular, though only the principal author or authors of each chapter are specifically credited all chapters have been improved by the input of other members of the team. I would also like to thank all of the external reviewers of drafts of this material, especially the members of the LTDI Consultative Group, who have commented on and supported this publication.

Greg Stoner

Editor
July 1996

2: What is learning technology? Some definitions.

Roger Rist and Sue Hewer

Learning Technology is defined as: The application of technology for the enhancement of teaching, learning and assessment. Learning Technology includes computer-based learning and multimedia materials and the use of networks and communications systems to support learning. Learning Technology clearly embraces a wide range of applications, some of which, in the past have been classified under various acronyms such as the following:

CAI	Computer Aided Instruction
CAL	Computer Aided Learning
CBL	Computer Based Learning
CBT	Computer Based Training

Newer technologies which are included within Learning Technology have also brought with them their own acronyms. For example:

CAA	Computer Aided Assessment
CMC	Computer Mediated Communications

An essential component in a Learning Technology package is the ease with which the learner can interact with the contents. This is often referred to as the HCI, or Human-Computer Interface.

The following categories indicate the main application areas for Learning Technology:

Drill and practice

Tutorials

Information retrieval systems

Simulations

Microworlds

Cognitive tools for learning

Productivity tools

Communication tools

A further category refers more to learning about computers rather than learning with computers. This is the use of programming languages and software to control equipment.

Features and characteristics of educational software

Drill and practice

Drill and practice packages offer structured reinforcement of previously learned concepts. They are based on question and answer interactions and should give the student appropriate feedback. Drill and practice packages may use games to increase motivation.

Tutorials

Tutorials are used to teach new concepts and processes. Material is presented to the student in a structured format. Tutorial software usually includes worked examples and gives the learner the opportunity to assess their understanding with questions, answers and feedback. Intelligent Tutoring systems are capable of corrective feedback and adapt their presentations to suit the learner, based on the actions of the learner.

Information retrieval systems

Information retrieval systems store knowledge in a structured way and allow the learner to browse or search for information as required. They include on-line databases; structured information systems such as dictionaries and encyclopaedias and also hypertext and hypermedia reference systems.

Simulations

Simulations model an experiment or a real life or imaginary situation. The context of the simulation may be a business plan or a laboratory experiment or an animation of the working of a chemical plant. Simulations usually are based on interactive graphics and give the learner the ability to visualise a process and explore the effect of changing parameters on the operation of the system.

Microworlds

Microworlds use the computer to create a problem solving environment and are derived from the work of the cognitive psychologist Jean Piaget. Seymour Papert, for example, introduced the Logo language into schools to encourage children to learn about mathematics in a Mathland microworld.

Cognitive tools for learning

Cognitive tools for learning are based on the constructivist principle that learners need to construct their own understanding of new concepts. These tools give the learner a way (often graphical) of representing their understanding of new knowledge and concepts and how they relate to existing knowledge and concepts. Expert systems and authoring tools can also be used in this way, allowing the learner to present his/her understanding in a way that can be accessed by other learners.

Productivity Tools

Productivity tools include applications such as word processors, spreadsheets, databases, graphics, desktop publishing and presentation packages. Whilst these tools are not specific to Learning Technology, if used within a pedagogical framework, they can support learning by enhancing the quality of the learning process and by improving student productivity. For example, word processing encourages drafting, reflection and editing and removes from the student the chore of having to re-write any written submission. Spreadsheets can promote a structured approach to problem solving and enable the student to spend more time on the task in hand rather than on routine or lengthy calculations. Databases can be used to help students, as well as staff, to organise information related to their courses and to develop their information handling skills.

Graphics and desktop publishing packages enable staff and students to achieve a higher quality of presentation. Good quality handouts make for greater clarity and improve student motivation. These tools also enable students to produce high quality submissions and encourage the development of transferable written presentation skills which will stand them in good stead in future employment.

Presentation packages provide much the same benefits for spoken presentations as the graphics and desktop publishing packages do for written one. They are clearly of great benefit to support conventional lectures, enabling the lecturer to draw together text and graphics. Equally they are helpful in enabling students to demonstrate their understanding of new knowledge and its applications, supporting them in the development of oral presentation skills.

Communication tools

Computer-mediated communication takes several forms including electronic mail, electronic conferencing, video conferencing and the World Wide Web. These tools allow learners to share ideas and information, to co-operate, to collaborate on joint work and can also be used for submission and publication of students' assignments and of tutors' comments on students' work.

Electronic mail (e-mail) is an asynchronous communications medium, not requiring the recipient of a message to be co-ordinated in time or place with the sender. Further, e-mail can be used one-to-many, as well as one-to-one. These characteristics are helpful in maintaining communications between tutor and student, tutor and students and among students since they overcome constraints of distance and time. E-mail is also a useful tool for course managers particularly where distance or open learning components are involved.

Like e-mail, **electronic conferencing** is asynchronous and can be used at a location of the user's choice, given access to appropriate equipment. It provides a structured forum for the exchange of ideas and, because of its

asynchronous nature, promotes reflective participation. It can be used to replace or augment, for example, face-to-face seminars where a student electronically presents a case and the rest of the group electronically debate the points raised. Here as the contributions are electronically 'saved', they are available for participants and tutors to review during or at the end of the conference, a factor that also provides a possible vehicle for assessment. Electronic conferencing need not be restricted to text, any form of computer files can be handled including, for example, graphics and stored sound.

Unlike electronic conferencing **video conferencing** is synchronous, the participants interact in real time, either one-to-one, one-to-many or many-to-many. Although one of the main benefits of video conferencing is to avoid travel it is often necessary for participants to go to a local centre which has the appropriate facilities, unless they have desktop facilities which support video conferencing. One of the objectives of the Scottish Metropolitan Area Networks initiative is to promote the use of video conferencing within the Higher Education system by the provision of video conferencing suites and network facilities capable of giving priority to video conferencing traffic.

As well as providing a range of on-line communication tools, on-line communications can provide access to the **World Wide Web** (WWW). The WWW consists of millions of information sites between which information providers have set up hypertext/hypermedia links. By visiting one site of particular relevance, you are likely to find at that site a number of links to other sites which will also prove of interest to you. The WWW is capable of supporting multimedia pages as well as plain text. It is by no means a passive resource. It is possible for staff and students to search the web to locate sites of interest, to give feedback to information providers through on-line comment forms and to create web sites for use within the teaching and learning process.

3: A conceptual framework for the integration of learning technology

Greg Stoner

Introduction

This chapter sets out an overview of a systems approach to the integration of learning technology (LT) into courses, modules or units of study. The framework draws on the systems analysis and design (SA&D) methodologies that are widely used and discussed in relation to the design and implementation of computerised information systems (see for example Lucas, 1994 and O'Brien, 1994). It is also informed by a systems approach to instructional design (see for example Gagné, Briggs & Wagner, 1988) and reflects elements of Laurillard's (1993) model of learning in higher education..

A life cycle model of Learning Technology Integration.

Figure 1 is an adapted version of the systems analysis and design life cycle approach (see for example O'Brien, 1994 & Bhaskar and Housden, 1990) that sets out the main stages in the integration of learning technology within teaching.

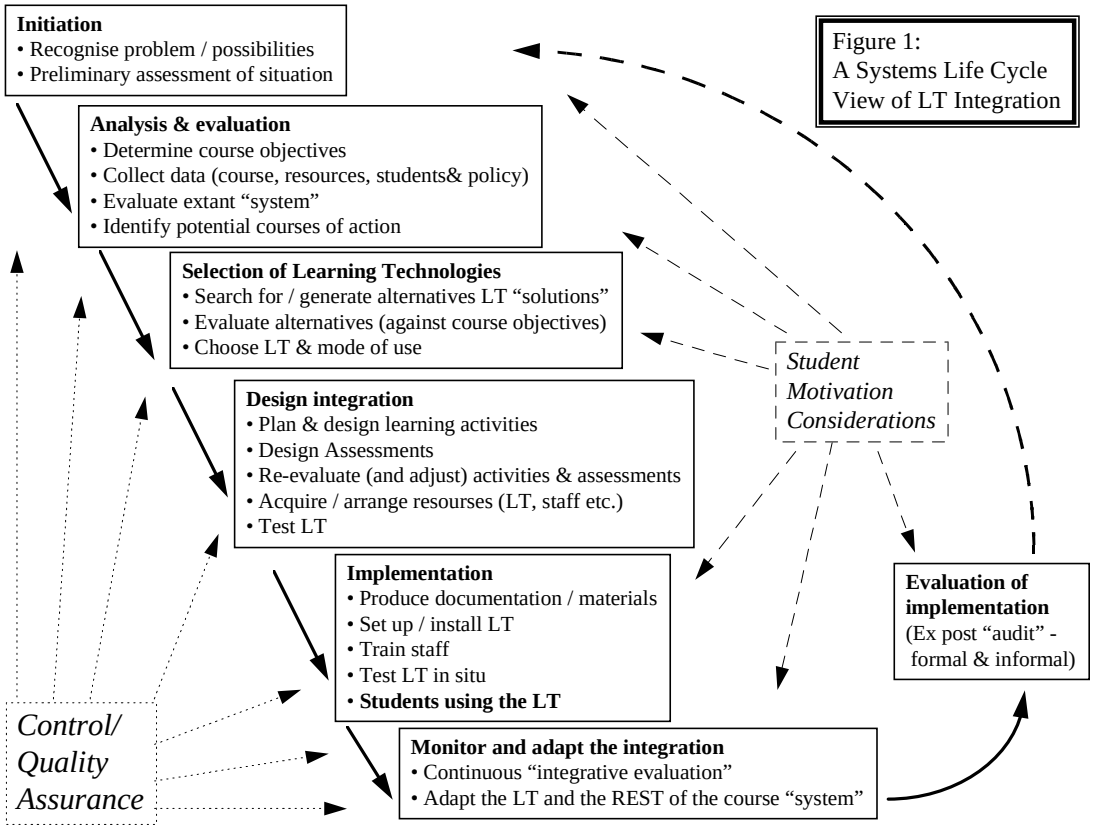

Figure 1:
A Systems Life Cycle View of LT Integration

This diagram presents the framework as an essentially linear model. This is a attribute of the presentation rather than the framework itself, an issue that I will return to after considering the different stages within the life cycle framework.

A tour of the activities in the LT integration cycle

Initiation

The first phase here is to recognise that a problem or possibilities exist. Such recognition may arise, for example, from;

- general awareness and monitoring of a course,
- formal course reviews,
- exposure to some LT materials or an LT implementation, or
- external initiatives or pressures (e.g. the need to contain costs or to appear to be "high tech").

Any proposed changes should be focused on the overall programme of study &/or the portfolio of courses offered by a department, recognising that each course (or module) represents part of larger systems. Thus minimising the probability of piecemeal change with possible dysfunctional effects.

Once recognised as an LT implementation possibility someone has to make a **preliminary assessment of the situation** in order to decide if it appears that this problem or issue is worth following up. The person or group involved may do so "officially" - with some form of formal agreement - or, more likely in many circumstances, a teacher/lecturer will decide that s/he wants to try out an LT implementation and to "champion" it through the relevant hurdles. Either way some commitment to a change process is required for anything else to happen.

The form of the commitment by an individual or group at this stage may well shape the final outcome of the change process in unfortunate ways. Once **publicly** or **psychologically** committed to a particular **solution** it may become self fulfilling regardless of its benefits and costs.

Analysis & evaluation

Within the context of LT implementations the key issues driving possible changes relate to the aims and learning objectives of the course (module) or courses being considered. Therefore the first phase here is to determine the course/module objectives, recognising that these are likely to be driven by the higher aims of the institution, department and programme of study within which the course fits. Clearly the problem or LT possibility identified may have implications for the aims and objectives of the course being considered. The use of LT may enable the course staff to expand or alter the course content or to enhance the transferable skills that are to be engendered in the course. The establishment of learning objectives may therefore be straightforward - reading them from extant course documentation - or may be a more complex process involving iteration and negotiation. It is important however that course aims & objectives are established to ensure that LT is used to further the agreed objectives rather than to divert them.

The next phase is to **collect data** on other aspects of the **course,** for example: the detailed syllabus; class contact times; forms of assessment and its position within the wider programme of study. Data is also required on the **resources** committed to the course, for example staff time (including an awareness of the speciality, attitudes and skills of staff), estate resources (room usage), laboratory/equipment usage (including IT resources) and other support resources. It is also necessary to collect data on the overall availability of these resources within the institution/department.

Data on **students** is also important. Some are obvious - such as: numbers; prior study profiles; general levels of ability; previous uses of IT; diversity of students' prior studies etc. Other student data is also relevant if somewhat difficult to collect due to its "softer" nature, for example: preferred learning styles; their attitudes to IT and the course subject; what motivates them to study; other course pressures and calls on their time and their career and future study aspirations. Finally, data on departmental and institutional **policy** on teaching and learning approaches and on the use of IT and LT needs to be gathered. Policy here may provide both opportunities and constraints and therefore provides important inputs to decisions on course development and the use of LT.

Evaluation of the extant "system" can then be undertaken to determine the degree to which the current course meets the agreed course aims and objectives, which may have been changed in response to the problems &/or possibilities considered. Not an easy task, possibly facilitated by tabling the

learning objectives against each of the relevant elements of the course syllabus, the course activities that engender those learning outcomes, and the assessment exercises that test students' learning of them. This mapping of the course structure can then be used as a guideline for considering data such as past student results, student feedback and course reviews, thus facilitating the judgement required to evaluate the extent to which learning objectives are met. The strengths and weaknesses identified in this type of evaluation can then be used to form the basis of reinforcing and corrective action.

Finally within this stage consideration should be given to a broad range of potential actions to improve the course and enhance its strengths, including non LT solutions. Promising possibilities should then be considered in more detail to **identify potential courses of action**.

Selection of Learning Technologies

Assuming that LT solutions are thought to have potential it is necessary to **search for/generate alternative LT "solutions"**. These will need to be formulated in some detail, identifying the LT/courseware to be used and how it might be used and integrated within the course(s) being considered. Ideally the generation of alternatives should be expansive, considering a wide range of possibilities both in terms of the LT to be used and the way that it is to be integrated. Within the UK HE sector there are several centres/projects that are able to help in the identification and integration of LT. These include the subject based CTI centres, the TLT Support Network and (within Scotland) LTDI. The other major sources of information include colleagues at your own or other institutions, conferences and publications. Additionally LT may be identified through publishers' catalogues and other advertising media.

Avoid latching onto the first LT solution that you encounter. It is important to evaluate alternatives. It is also important to guard against the "not invented here" syndrome which can pre-judge the outcome of your evaluation - perhaps by excluding it from your list of alternatives. You may well be able to adapt or customise existing LT materials to your requirements or use them in a novel way. Another option is to develop your own LT courseware, if nothing else suitable can be found. This could be a major operation and should be avoided unless you are aware of the time and resources that will be required and are willing to commit them to the task. There are of course exceptions here including LT based course integration solutions and building small scale CAL materials using authoring tools/packages. Whilst the development of LT can be set within the context of this life cycle framework detailed consideration of the LT development process is beyond the scope of this publication.

Once established it is necessary to **evaluate the alternatives,** the possible "solutions", against the course aims and objectives taking into account the overall learning environment that is offered to your students and the skills and knowledge that students are expected to bring to their studies. The most obvious aspect of this evaluation is to compare each alternative against the course learning objectives established earlier, however it is also important to consider the wider student learning environment, student competencies and the resource implications of each alternative.

From a student perspective consider the balance of learning experiences that they are exposed to and the transferable skills that they are likely to develop and also the extent to which the LT "solutions" provide alternative modes of study for students, in order to enable them to choose modes of study that maximise their learning and skills development.

Alternative LT "solutions" also have to be evaluated in terms of their resource usage, recognising that some resources may be freed-up by the implementations, either directly or due to knock-on effects. It also has to be recognised that resource issues will be viewed from different perspectives; those of the institution, the department, individual members of staff and students. For example, using LT may free-up formal staff contact time but put strain on computer lab resources and students time.

Within this phase the dangers of the "not invented here" syndrome are again present. It is too easy to dismiss an alternative on the grounds that it is "not the way we do things here" or that this LT "doesn't cover subject XXX the way that I would have done so" or that "it covers YYY and not ZZZ and would therefore require a change in the syllabus" etc. These criticisms may well be true but are they important, or just an excuse for inaction? Perhaps the "problems" can be worked around or mitigated in some way, or even drawn in as a positive aspect.

Having evaluated the alternatives it is necessary to **choose which LT materials** are to be used **and their mode of use** within the overall course design. This is a complex decision balancing a wide range of decision criteria. There are several aspects to choice (at this and other phases):

- **Who** makes the decision? This is often far from clear cut within an academic environment as the course/specialist staff often lack the authority to commit resources and those who have resource power may not be able, or even wish, to dictate detailed curricula matters. Furthermore the choice has to be made in a political environment and take student views into account.
- **What factors** are to be considered in the decision? In particular what are the prime objectives, what are acceptable levels for "other" objectives and what factors otherwise constrain the choice?
- How are the factors to be **measured**? If indeed measurement *per see* is important/feasible.
- How are the various factors to be **compared** to reach a decision? How are the multiple criteria to be balanced? What are the grounds of choice?

Clearly the desirability, and actuality, of change is driven by the benefits and "costs" of change. Within the context of integrating LT into teaching the principal groups and individuals with a stake in any change will all have different perspectives on which factors should be included in the cost benefit evaluation and their relative weightings within the overall assessment of benefit.

The choice made at this point determines the remainder of the integration cycle - and is thus critical.

Design integration

The previous stages of the process have required that consideration be given to the integration of learning technology within the overall learning strategy of the course. At this stage it becomes necessary to design the integration and co-ordination of all of the learning and assessment activities of the course, including LT based activities, at a detailed level.

Within this design process one of the key considerations is that of maintaining and if possible enhancing student **motivation**, a difficult area in much of higher education which is referred to below and in chapter 9.

The key issue in course design is **integration**. Several observers (including Benton, Elder & Thornbury, 1995) have identified this as the main deciding factor between the success or failure of LT implementations. LT materials that are "bolted on" to the main structure of the course are likely to remain largely unused - failing the first condition of a successful implementation of technology in teaching. Appropriate integration strategies will depend on the circumstances but are likely to include some of the following:

- Reference the LT materials in course documentation, including details of which materials/parts are relevant to each topic/learning objective.
- Ensure that students have the required IT skills to enable them to concentrate on the learning, rather than the technology.
- Ensure that the LT is readily available to students, when and where they can use it.
- Avoid barriers between LT resources and other course resources and activities. Consider setting up an on-line course materials support system to provide automated and seamless access to LT/CAL as well as course/lecture notes etc. This can quite easily be done using internal World Wide Web (html) pages, other hypertext tools or simple menu systems.
- Use LT as a suplantive (instead of) resource where it is appropriate to do so - even for key aspects of the course.
- Choose appropriate assessment strategies and activities, ensuring that students know that the materials covered within LT materials are assessable (see chapters 3, 4 & 10).
- Consider logging use of the LT materials and making the logging of use "public" or even making the LT compulsory.

The detail of the steps to be taken within this stage of the process are heavily dependent on the course subject, level and the LT to be used, amongst other things. The following paragraphs provide a guide to the main issues to be addressed.

Plan and design learning activities: Think again about everything that students might be doing within/for the course as learning activities. It is important to consider the mix and sequencing of learning activities, taking due account of the physical as well as the pedagogic nature of the activities that we expect of students. LT materials can be novel and exciting if used sparingly and appropriately but can become tedious for some students if they are expected to work for long periods in front of a screen. Students are most likely to learn from active involvement in the process of learning. LT solutions can be very solitary (suiting some students) and passive. So, think of ways to encourage interaction between students as well as with staff, plan these activities and design them into the course.

Design assessments: an important element of almost all courses in higher education, particularly as fear of failure &/or the desire to excel are arguably the prime motivators for students. Ensure that assessments are not only appropriate for the course learning objectives but also that they motivate students to complete the necessary learning activities in an appropriate way. In particular ensure that assessments are set which test that students have adequately completed IT based learning activities, see chapters 3, 4 & 9. Also consider using computer based methods of assessment, see chapter 10. Computer based testing can be used as formal assessment and to help monitor students' progress when their learning is less easily observed by their lecturers, as is often the case with LT integrations.

Re-evaluate (and adjust) activities and assessments: It is easy to get "bogged down" in the detail of course design. It is therefore important to re-evaluate the overall shape and content of the course, including the way that the learning and assessment activities are related to each other, to ensure an appropriate balance. No course design is perfect, so expect to make changes.

The tasks of **acquiring and arranging the use of the resources** required for the integration of LT are essentially practical and political, rather than pedagogic. It is important to recognise that the resources required are not just the courseware itself and the computers to run it on. Furthermore these issues are tied up with funding, hence they are political. Implementing LT may require the political skills &/or power required to tap into Departmental, School or institutional funds. These and other practical issues are addressed in chapter 8.

As with any IT based activity it is vital to **test** out the **LT materials** on the type of equipment and, where relevant, networks on which it is to be used with students. Observing not only whether or not it operates, but whether it does so in a usable way, e.g. at a reasonable "speed" and whether the screens are clear at the resolutions being used. It is also a good idea to check that the LT will work when a large number of students attempt to use it simultaneously. Will it crash when 30 students simultaneously access the package or a file within it? Remember that is what is likely to happen when a class starts. If possible get students to test the software and take note of their views, see evaluation chapters 7, 11 & 12.

If tests fail consider ways of getting round the problems before giving up, possibly lobbying the account holder to provide funds for any necessary upgrades or acquisitions.

Implementation

Having designed the course and LT integration a few important implementation issues are likely to remain.

Produce all the documentation & materials required for the LT based learning activities in good time and ensure that all the materials are updated for any late amendments to the course &/or the courseware being used.

Set up/install LT: Ensure that the software is properly installed in the computing environment(s) to be used by your students, including its accessibility from remote/out of hours computing facilities as relevant. Expect differences between versions and across different environments - particularly with networked software. Also try to ensure that the courseware is easily accessible, in as transparent a way as possible to avoid barriers to students who lack confidence in their IT skills.

At a more technical level ensure that the software is correctly set-up in terms of where it expects to: find data; store students work and log students' usage (where appropriate). Also make sure that any subsidiary facilities that you will expect students to use are readily available to them, e.g. a notepad/word-processor for students to use for their own notes, an on-line calculator or other packages. Finally don't forget the "low tech" side of the installation, for example: ensure that desk space is available if students are likely to need it; put up notices to remind students of where to find the courseware and who to go to for help.

It may be necessary to **train yourself and other members of staff** (lecturers, tutors, demonstrators, first line support staff, technical/operational staff) in the use of the courseware and other elements of your students' computing environment. Your colleagues may well lack confidence in the technology &/or your approach to its use. Minimise your own and your students' problems by ensuring that they know what they are expected to do and why. Remember that it is in your interests to train whoever is most accessible to the student when using the courseware to deal with problems or queries that may arise, so do so.

Test the final versions of the LT in situ, where your students are going to use it**.** Ideally you will have done this at an earlier stage, however in practice this is often not possible. Check it now, taking account of the points noted under testing in the design stage...

Finally it is time to get **students using the LT**, but before you let students lose on the materials make sure that you have taught them all they need to know to use the courseware (perhaps very little) and why they are using it. Do your best to ensure that they are motivated.

Monitor and adapt

Unfortunately all is not over once the LT implementation is underway. It is important to maintain the "system" - to monitor what is happening and instigate any necessary adaptations.

Continuous "integrative evaluation": The monitoring of any implementation is best seen as a continuous process of taking into account students' experiences of using LT materials in the context of the course on which it is being used. It is important that this process is continuous and in "real-time" so that problems can be rectified before it is too late - before the students' learning opportunities have been lost.

At this stage in the process it is probably too late to radically change the way that the course is to be taught (this year) and as stated by Draper the main issue in many LT implementations becomes "how to make the best use of CAL material ...[we] are already committed to using" (chapter 11 p62).

Adapt the LT and the <u>rest</u> of the course system: Adaptation is an important element of any LT implementation, as with any teaching, in order to deal with the problems and opportunities identified as well as dealing with the dynamics of teacher - student and student - student interactions. This is why continuous monitoring is important, allowing us to adapt the course to deal with problems and take advantage of opportunities that may arise. This is likely to give rise to changes in the non-LT as well as the LT elements of the course. In fact the difficulties of altering programmed IT resources is often such that it is more practical to alter the non-LT elements. Just like we are used to working round the problem sections of text books.

Evaluation of implementation

The final stage of the life-cycle is to stand back and review what you have achieved.

> How successful has your introduction of learning technology been?

This is an important and interesting question that is easily asked but not easily answered. Evaluations can take many forms. At one extreme are the formalised experimental approaches that are addressed in chapters 11 &12. At the other are the informal methods that we all rely on to some degree in our evaluation of our teaching - did it feel right, did students seem to complete the work, did we get lots of hassle from disgruntled students, did they perform well in their exams, etc. Informal but potentially valuable methods - particularly where time and resources have not been set aside for more formal evaluations.

Though formal evaluation is discussed elsewhere it is worth noting here that formal evaluation normally requires planning at an early point in the implementation process.

It is through evaluation that we are most likely to identify problems in our course designs and/or to identify potential improvements. Hence our evaluations lead us to back to the beginning of the integration life-cycle framework.

Student motivation

Without some motivating force students are unlikely to learn. Therefore we have to address the fact that the way that we teach is likely to be an important factor in students' motivation and learning. Figure 1 indicates that student motivation has the potential to affect all stages of the LT integration cycle. In particular we have to be aware of the potential positive and negative effects of incorporating IT in our teaching. In most circumstances students are unlikely to be directly involved in the integration process, hence the influence of student motivation will be largely indirect. We, as the teachers, have to consider student motivation issues as best we can through empathy with the students' situations. Perhaps we should consider higher degrees of student involvement in the design of courses in order to foster motivation. Motivation is discussed further in chapter 9.

Recursion within the LT integration cycle

Having considered the activities within the LT integration cycle I now return to my comment that preceded that discussion. Whilst the activities are presented in an order, the sequence in which they are undertaken in practice is likely to be far less ordered. At many stages within the process it is very likely that previous decisions &/or evaluations will be thrown into doubt, leading to a degree of recursion to reconsider these earlier decisions. Recursion to previous stages in the process is not a problem - but a strength of the framework. It provides an overall structure to the integration process without imposing arbitrary constraints and explicitly allows for the recursive nature of many complex decisions. This is neither a failure of the framework or of practice, provided that recursions are controlled within the overall management of the change process and decisions are ultimately made and acted on.

Control & Quality Assurance

Figure 1 shows control and quality assurance to have an influence on all stages of the process of LT integration. These are two interrelated aspects of systems control. Control refers to the control and management of the process of change, ensuring that the process achieves the immediate objectives of providing solutions to identified problems, using Learning Technologies to do so as appropriate. Quality assurance refers more directly to control of what is being changed - the course - ensuring that learning objectives are met by students in an appropriate manner.

Conclusions

This chapter has explored the process of Learning Technology integration seeking to address the issues raised by the two questions:

- Is there a right way to implement LT?
- If yes, what is the right way?

Unfortunately there is no single right way, because the complexity of change management is such that it is unrealistic to seek "universal solutions". The second question is therefore inappropriate. However, it is hoped that the discussion above provides a framework which will help us to decide on appropriate ways of implementing changes in courses, particularly those concerned with the introduction of Learning Technology. I would like to end this chapter with a few concluding thoughts derived from this methodology.

- The quality of courseware or other LT is important to the success of its implementation in teaching. However, the more important issue is the quality of the **integration** of that LT into the students' course of study. Weak integration can all but destroy the effectiveness of the best LT whilst good integration can extract value out of even the most basic LT materials.
- Introducing LT into courses involves change, not just of the course materials but of a wide range of student and staff activities and attitudes, of the usage of other resources and even potentially the

structures of the organisation. Ideally these changes should be considered in a systematic, flexible and supportive way.

- Evaluating the effects of the introduction of LT or changes in the way that we integrate it is important. Without doing so we are unlikely to improve the quality of our teaching (and risk being drawn along the route of cost reduction irrespective of the quality of our students' learning experiences). This might not mean that we formally evaluate each and every change to our courses but we must be aware of the potential effects of our teaching and be on the lookout for good and bad results from our implementations of LT.
- Motivation of students to effectively use integrated LT is important - probably the key element determining the quality of any LT implementation. However, motivation of staff is sure to be the key issue in whether or not LT is successfully integrated into courses and therefore that the potential of LT in teaching is realised. For this reason staff motivation has to be considered seriously - there is a limit to the amount of effort that teachers can be expected to put into LT integration for altruistic reasons, or even because they enjoy IT. Organisational systems have to take into account the changing nature of teaching once LT is introduced - assessing work load on the basis of the number of lectures/tutorials held will always mitigate against student centred learning using LT.

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Most of the issues introduced in this chapter are addressed in more detail in subsequent chapters.

A more detailed version of this chapter is available from the author and is to be presented at ALT-C 96, the Association of Learning Technology annual conference, 16-18, September 1996.

4: Experiences and best practice in the use of learning technology: A personal view

Alan Sangster

Editor's Introduction

Alan Sangster has been using LT in his teaching for many years and in this chapter he presents his views on the practical issues that arise from its use and how LT might best be used within the curriculum. This chapter is based on a presentation given by Alan Sangster at an LTDI workshop in December 1995, a workshop directed towards the disciplines of accounting and finance, therefore some of the examples are subject specific. However, the general message of this chapter reflects the experiences of many experienced users of LT and is not specific to accounting and finance.

Technology used in the learning environment

The technology commonly used within the learning environment includes:

- Blackboard
- Whiteboard
- Ohp
- Video
- Laser disc
- Audio
- Computer
- Computer projection
- Video conferencing

While most of these are used solely by the tutor, video, laser disc, audio, and computers are also used by students on their own. Within the context of these student-used learning technologies, the learning environment can take six broad forms:

1. Proprietary CAL, CBL, CBI, CAI, etc.[1]
2. Home-made CAL, CBL, CBI, CAI, etc.
3. Objective test authoring packages
4. Student knowledge engineering
5. World Wide Web
6. Electronic mail

Of these, the first three have been in use for many years. The last three are much more recent developments.

Proprietary CAL, CBL, CBI, CAI, etc.

Use of these types of packages is now widespread in many disciplines. Within the teaching of accounting and finance examples include the commercial packages PEER, EQL Bookkeeping, ISL, Understand Accounts, and

[1] CAL (computer aided / assisted learning), CBL (computer based learning), CBI (computer based instruction), CAI (computer aided / assisted instruction) are amongst the many acronyms used to describe various forms of computer mediated teaching tools. Definitions are not provided or strictly relevant here.

the TLTP software BITE, and Byzantium. None of these packages existed in the early 1980s, and the TLTP software only started to be released in its final form in 1995. Despite the relatively recent development of these types of materials, use of packages of this type is now widespread, with EQL Bookkeeping, for example, being used in the vast majority of UK university accounting departments.

When use of these types of packages has been unplanned, unstructured, or unintegrated, the impact on the learning environment has been very mixed. Possibly only the most conscientious students spending sufficient time and paying sufficient attention to the material to benefit. However, when their use is planned, structured, and integrated into the learning environment, the impact upon the learning experience can be pronounced, with *accelerated learning*, *increased coverage*, and *learning control transfer* (to the student from the tutor) all being not just possible, but guaranteed if desired and planed for by the tutor.

Home-made CAL, CBL, CBI, CAI, etc.

While home-made material of this type has existed for as long as computers have been used in education, it has not been until the last few years that the quality has matched the needs of adopters. Thus, take-up of the earlier packages was not marked, most preferring to write their own applications using computer languages like Basic. More recently, there has been a distinct shift towards the use of spreadsheets, due to their macro facilities and the option to incorporate visual basic. However, these require the development of a fairly high level of expertise in the use of software. Skills that would not necessarily be used by the tutor in other work. As a result, many tutors prefer to use software created specifically for the purpose of developing CAL type material. The most used products include Toolbook, Authorware, and Guide.

Similar potential benefits arise as with the proprietary products. In fact, the benefits may be even more pronounced because, as these packages have been developed by the tutor, their use is generally more likely to be planned, structured, and integrated into the learning environment than the use of proprietary products.

Both proprietary and home-made packages of this type can significantly enhance the learning environment when effectively integrated into the curriculum. Integration is vital -- without it, there is little point in acquiring these packages, students will not use them. Buying one, or writing one, and then placing it in the library as a study resource may get 10% usage, but usage is more likely to be nearer to 1%. Even where the package is integrated into a course (for example, by setting aside previous lecture contact time for computer lab access of a CAL package) this control transfer aspect (which should improve and enhance the learning environment) has a considerable downside - as with a course textbook, students will tend to minimise their use of the package unless they perceive that there is a real need to use it. Student motivation is therefore important. One way to address this is through the use of objective testing software.

Objective test authoring packages

These include proprietary packages like Question Mark and EQL Assessor, but there are many packages available, including some that are free.

Apart from the creation of formal objective tests (OTs) where none previously existed, computer based objective testing can be used;

- to replace paper-based OT exams, both formative and summative[2],
- to provide revision resources,
- to increase the coverage of a course,
- for increased direction by implication, and
- to keep control when CAL is used.

The norm is to assume the first two are the only potential uses, and this is where most of these tests are focused. However, the greatest boost to the learning environment may lie with the other three uses.

OTs can be used to increase students' coverage of material by testing all aspects of a syllabus, thereby encouraging students to consider all the material, rather than attempt to 'spot' topics. Through their topic focus,

[2] Summative assessment being assessment that counts towards the course result, formative assessment providing feedback to students on their progress / understanding of course material.

OTs can indicate to students which aspects of a syllabus are important. In conjunction with CAL material, they can be used to ensure that material is studied by students. The use of a CAL package without parallel OTs can be pointless. Even a summative exam question on material covered solely using CAL can be ineffective, particularly if students can elect not to answer it. Hence, students may have little incentive to use the CAL package.

Student-controlled use of a CAL package needs integrated testing if it is to be an efficient form of learning. A compulsory formative OT linked to each topic is a step in the right direction, though some students may still choose to do no more than superficially use the CAL package. If the OTs also have a minimum performance standard linked to permission to sit the summative exam, students will use the CAL package and the tutor can be reasonably confident that material taught only through that medium is not being omitted by students.

Similarly, and just as effectively, a series of formative OTs which are released for practice after each test is completed, followed by a summative OT covering the material included in the formative OTs will ensure students make full use of the OTs. (Practice versions of the OTs should include answers and explanations.) The difference in this approach is that the OTs themselves will be used by the students to learn the material. The students are likely to see the OTs as the main instrument of instruction, referring to their textbook, CAL package, or lecture notes only when they do not understand why the given answer is correct. If a CAL package is being used in conjunction with this form of OT integration, the OTs must be very carefully designed to ensure they effectively cover the material. Once the practice version of an OT is released, students will not tend to be inclined to refer again to the CAL package. Consequently, it is worthwhile requiring all students to achieve a minimum standard on a formative OT (after multiple retakes if necessary) before making a practice version OT available.

In fact, use of OTs in this way can also be applied to material taught in conventional ways, underlining the enormously undervalued potential benefits of OTs. Students can be encouraged to study, are immediately rewarded for doing so (through the feedback they gain on the OTs), and achieve better summative exam scores as a result. Tutors can identify both topics that are causing difficulties and students who are experiencing difficulties. Furthermore, because OTs concentrate upon knowledge and application, students form a more solid base of knowledge and understanding than is typically achieved in a more conventional learning environment. This enables greater depth of topic coverage and greater evidence of analysis and synthesis in student summative essays. This is even more evident through the use of another form of educational technology -- *student knowledge engineering*.

Student knowledge engineering

Student knowledge engineering involves students in building their own computer-based representation of the subject material. As a concept, this is not based on anything new. Students have always written essays, sometimes long essays on specific topics. Where it differs is that this approach entails students constructing expert systems (computer packages that emulate the output of an expert) using packages called ‘shells’. The most commonly used (and very cheap) expert system shells are *Crystal* and *VP-Expert*. In order to write one of these expert systems, students need to understand the topic in depth. They can start with superficial knowledge but writing the expert system will highlight flaws in their understanding and lead them to improve the accuracy and depth of their knowledge and understanding.

Effectively used, this can lead to accelerated learning (students learn very quickly as they are constantly being corrected), deep understanding, and results in complete control transfer to the student in a far more controlled manner because the student not only has to complete the project, but knows when the knowledge is flawed. The software is very easy to use, taking no longer to learn than it takes to learn how to make basic use of a spreadsheet. [For detailed coverage of this topic, see all of *Accounting Education*, Volume 4(3), 1995.]

World Wide Web

This is *the* future environment of educational technology. Distance learning will use little else, and students based locally to their institutions will use it from home, leading to most students learning, at least in part, in a quasi distance learning environment. Software currently in use for viewing material on world wide web includes Netscape and Mosaic, both of which are free. Virtually any software can be used to create material for world wide web and, although sophisticated page design requires some (but not a lot of) expertise, a basic web page can be constructed by a beginner virtually instantly using some of the free facilitating software available on the WWW. It is currently possible to present text, graphics (still and video), and sound, and it will not be long

before the viewer software will be able to present documents prepared for other environments (e.g. Powerpoint slide-shows) in screen windows at the click of a link.

The educational potential of world wide web is vast. It can, for example, be used;

- to deliver course material
- to provide revision resources
- to provide an environment for assessment (a web version of Question Mark is available, for example), and
- to develop IT-awareness

It can also be used for another form of student knowledge engineering -- *student knowledge identification and dissemination* -- with a focus on knowledge discovery, collation, and presentation, rather than knowledge clarification and understanding.

This is the environment where CAL material will be based, where OTs will be conducted, where videos will be viewed and listened to, and where information of relevance will be sought and acquired. The software is so flexible that it can be applied to a local area network just as easily as to the wide area network in which it is perceived to belong. Hence the likelihood that all computer-based instruction and learning will move to a standardised interface using world wide web software.

Students like this environment. They enjoy the challenge of discovering the unknown, of the discovery that people other than their tutor have made material available on the topic in which they are interested, and they enjoy the freedom it gives to control their own educational discovery process. They do not enjoy the slow speed at which it can operate. Therefore today's academic adopters and integrators of Web technology into their courses may need to make local copies of as much of the material they intend to use as possible. The Web is also, incidentally, ideally suited to obtaining a wide variety of project submissions from very simple assignment definitions.

Electronic mail

Electronic mail (e-mail) is the most underrated and yet most freely available of all the electronic technologies. There are many different software packages available -- Eudora, Simeon, Elm, Pine, for example - and most e-mail operates seamlessly across all the various networks and interfaces currently in use. All that is required is an interface to the network, and electronic mail is available. Netscape has its own mail software integrated within it, as do Microsoft Windows for Work-Groups and Windows 95.

E-mail is not merely a device for conveying messages, it can also be used;

- to operate class-wide support,
- to administer assignments,
- to facilitate access to tutors, and
- to develop computer confidence.

Responses to frequently asked questions can be circulated to all students in a class instantly; students can be sent a reply to any query they may have on the material they are studying, irrespective of whether the tutor or the student is on-campus or not (and all their colleagues can received anonymised copies); errors, omissions, administrative information, assessment assignments, assessment results, reasons for absence, notification of illness - all can be relayed to whoever is appropriate instantly. Course administration becomes much simpler, students gain a sense of personal contact with tutors that is impossible face-to-face with the increasing pressure on staff time currently being experienced. Where part-time tutors are used on a course, taking tutorials for example, e-mail enables them to become far more integrated into the course as a whole, far more aware of the various issues being raised by students (and staff), and far better placed to respond to any issues that arise during their contact with the students.

If objective testing software is the route to effective integration of CAL in the curriculum, electronic mail is the route to significantly increased effective use of staff time. Large courses will run far more efficiently and smaller courses will become far more group-oriented as students and tutors get involved in e-mail discussion groups. Students generally like the immediacy of e-mail and the anonymity of the interface. They do not feel so

concerned about approaching a tutor for advice electronically as they do about doing so face-to-face. As a result, problems tend to be solved more effectively when an e-mail forum exists, and overall student performance enhanced as a result.

More than any of the other five resource types, e-mail should be being adopted among educators as an indispensable learning technology. There are no programmed risks in using it, no possibility that students may suffer from using it (as they might, for example, as a result of using a faulty piece of CAL, or as a result of an error in OT software). In short, it is a 'must-be-used' tool. Unfortunately, it is currently very under used, but this is changing with its use as a piece of educational technology very much on the increase, particularly in the US.

Requirements for successful IT-integration

In order for IT-integration to be successful, a number of factors must be present:

The integrator must have 'ownership' of the approach to integration

The integrator must believe that the method of integration adopted is appropriate. Otherwise, corners can be cut and compromises can arise in the integration, with any problems or difficulties being shrugged-off as someone else's fault; and the integration as a whole may be undertaken with insufficient care and attention.

Patience

Integration always takes longer than anticipated before it is 'right'. In fact, it may never be possible to get it completely 'right', as software and hardware are constantly changing. The integrator must be aware of problems when they arise, and must be willing to redesign the process time and time again, until it works. In order to achieve this, the end result must be monitored extensively, student feedback gathered as often as practicable and feasible, yet not so often as to interfere with the student learning experience.

Time

It will always take longer than expected. It does not take hundreds of hours to prepare one hour-equivalent of CAL material, but it will maybe take tens of hours to do so. For the preparation of Powerpoint presentation slides for lectures, allow something between a 3:1 and 6:1 ratio, time:lecture hours. For a twenty question OT, allow between two and six hours for preparation, but expect errors, which will add further time to the process of getting it right. (Many of these errors will only appear through use, and will often be pointed-out by students, some of whom will not be very happy at having found them.)

Firmness with students and colleagues

Some students will always resist the use of technology in the way intended, some because it does not suit their learning style, others because they are unwilling to adjust even though the medium would suit their learning style. These students must be coaxed even, hard though it sounds, coerced into using the technology in the designated manner. They will all ultimately use it and all, even the strongest opponents, will benefit from doing so if what has been integrated has been thoughtfully done and is educationally appropriate. Any sign of weakness on the part of the integrator, indication that use is not, after all, required, will result in significant non-use, to the point where it undermines the educational impact and seriously disadvantages those students who avoid use.

The resistance-to-change of colleagues can also be a significant hurdle, and the integrator must develop a fairly strong detachment from the comments that may be encountered. Colleagues who feel strongly about this issue may not be averse to airing their views in public in front of or directly to students, and it is here that the integrator's resolve is most tested.

Self-belief

Without strong self-belief, all the opposition from students and staff will take effect and the learning experience will be effectively diluted as a result.

A willingness to assess effectiveness

How else will an integrator ever know if integration was successful unless time and effort is expended assessing it? It must be done, or all the resistance, and all the criticism will ultimately succeed in having changes made, as the integrator has no objective idea whether the approach has succeeded or not. Time must be used to assess effectiveness, to gather information that can inform the process of adjustment, and to ensure that the method of integration is appropriate.

An ability to overcome frustrations

Many unforeseen problems are liable to arise, from double-booked computer labs, to different versions of software available in computer labs, to computer network crashes, to PC projection equipment failing at the most inopportune moments. Any of these could lead the less relaxed integrator to abandon the enterprise on the basis that it is infeasible. Anyone undertaking the integration of educational technology must be prepared for every eventuality, or the integration is liable to be ultimately abandoned.

A thick skin

Overall, an integrator of educational technology must have or develop the ability to brush off unwarranted criticism and work around unwelcome barriers. It is a high profile activity and an easy target for its many, more traditionally focused, opponents.

Depressors of successful IT-integration

Software bugs and hardware problem

Software bugs and *hardware problems* are obvious depressants, as is a continuing, though diminishing, level of *computer illiteracy* among both students and colleagues.

Crackers

This is a growing problem. These people who delight in causing havoc in computer systems are becoming more and more prevalent and can cause problems that the best planning in the world could not have foreseen. For example, OTs held in a date-stamped and password protected file at one university recently had their date stamp and password protection removed, resulting in an exam that was not due to be sat for a further four weeks being freely available to the students throughout that period.

Red-tape

Many potential barriers can exist, depending on the rules that apply within an institution. It may be possible to implement integration virtually immediately, or it may take six months to gain approval through a series of committees, and then it may take a further three months before a place in the queue is available for the relevant software to be mounted on the network. It is important that such barriers be identified early and that steps are taken to minimise their potential impact as soon as is practicable.

Lack of resources

Many of the best CAL packages, in accounting at least, are proprietary. As a result, they cost money, maybe as much as £5,000 for enough licences to make integration of the material a viable option. Yet, money is not readily available in UK higher education to purchase software on this scale of cost, and a number of institutions currently prefer to invest money in in-house developed material.

This short-sighted insistence on the reinvention of the wheel encourages inefficient use of staff time and resources and the development, in some cases, of material that is inferior to what was available in the market at a fraction of the in-house cost.

It is wiser, in these circumstances, to insist on purchasing the proprietary product. In fact, in the case of some products (for example, taxation CAL packages) complexity of the topic may mean it is the only feasible way in which the material could be acquired. Delay experienced while resources are obtained is a small price to pay for access to an appropriate standard of product.

No recognition for the effort expended

All integrators of educational technology have long since realised that there is unlikely to be any recognition by peers or superiors of the extent of the effort expended. It must be seen as a labour of love and all thoughts of promotion, or increment advancement as a result of all the effort invested must not be looked upon with any element of expectation, or disappointment and frustration will be very likely to arise. There have been exceptions, but they are few and far between. For the majority, the best that can be hoped for is an improvement in student performance, student satisfaction, student feedback, and staff satisfaction -- not a bad group of rewards in most educationalists' eyes! But potential for irritation at the lack of recognition will likely still remain.

Best practice for successful IT-integration

There are some simple rules that should be followed if the integration of educational technology is to be a success:

- Know your software.
- Plan well in advance.
- Test everything where it will be used.
- Be open with the students.
- Be open with colleagues.
- Avoid re-inventing the wheel.
- Do not panic.
- Use it for educational benefit, not because it is there.

Benefits of successful IT-integration

Successful integration will lead to:

- Students learning more.
- Students learning better *how* to learn.
- Increased computer literacy among students (and staff).
- Increased computer confidence among students (and staff).
- Greater variety in the learning environment for both students and staff.
- Better pass rates.
- More interesting work.

It is worth the effort!

5: So you are thinking about using Learning Technology

Nora Mogey

This chapter is to help you think about a few of the issues that should be considered while you are deciding whether or not learning technology is for you. Questions will be posed throughout the chapter, some of which may not be welcome, but which can introduce some helpful angles from which to think about your teaching.

What are your aims?

No new courses will be truly successful unless they have been properly planned. Lectures which are carefully prepared and tailored to both the course and the students are much more effective than those which are only sketchily thought out beforehand. This statement is especially valid for the use of technology when many other variables interact with and confound the educational environment.

Following best educational practice the starting point must be the aims and objectives for the introduction of technology. Why exactly are you thinking about using learning technology as part of your teaching? There are many possible motivations, or more often a combination of motivations, and any or all of them can be very laudable.

The ever changing environment as your motivation to use LT

Universities in the 1990s are very dynamic environments with an increasing emphasis on efficiency and financial accountability. Many staff find courses changing to fit in with new university structures or delivery methods, and increasing competition for shared resources such as laboratories and teaching rooms. Can technology offer one method of addressing some of these issues?

"We just can't spare the time to reteach the basics that the students should have learned at school."

It would be most unusual for all students to begin courses with equivalent background knowledge. Some students have a very weak grounding in material that is an essential foundation for their degree, yet it cannot be justified to recap this material within their University course.

Possible LT solution - Offer an initial diagnostic assessment test, (perhaps between confirmation of the place and matriculation, or in the first week of the course?) to establish the basic level of understanding for each individual student. In many cases this could be a multiple choice test, delivered and marked automatically, to identify individual weaknesses. There is little reason why the same test could not be used for several years, reducing the added workload for staff. Direct students to a bank of self study resources (texts, videos, CAL packages, ...whatever is appropriate). Offer a special support tutorial, (perhaps in a computer lab) where these students can seek extra support from staff and amongst themselves. Many CAL packages offer detailed tutorial instruction and self assessment questions to help students consolidate their knowledge. Monitor the progress of these students and offer them a further formative test to establish whether any (or hopefully that an) improvement has taken place**.**

"Our class sizes are constantly increasing; I need another way of handling tutorials."

In large tutorial groups some students are reluctant to speak out, or to participate in the discussions. Perhaps they absent themselves from the classes.

Possible LT Solution - Provided it is possible to get access to a suitable room, a computerised lab can be run any number of times, to allow each student to get equal opportunities to access the materials. Run traditional tutorials every fortnight for half the class, and set the other half a lab session using CAL materials, demonstrators can be used to provide extra guidance.

"I would like to encourage the students to feel free to come to my room to seek help, but more and more that is meaning that I can hardly get on with my research"

Do groups of students often ask the same question as each other? Are there likely to be other students who are wondering the same thing but never felt able to ask? Are a lot of enquiries to do with routine or administrative issues?

Possible LT Solutions - Set up an e-mail group for all the students in the class. Encourage students to ask questions electronically rather than by calling at your office, then you can deal with the questions when it suits you. Post questions and answers to the list (omit student names, perhaps). Encourage students to respond to questions from their peers (but monitor the responses, to correct any factual errors). Make last year's questions and answers available for browsing. Make copies of lecture schedules (or lecture slides & notes) and information about supporting resources available so that students who know they must miss a lecture can try to catch up. Use e-mail to remind students about assignments and completion dates so that missing a lecture does not constitute a ready excuse.

Enhancing the student experience as your motivation to use LT

Student learning styles vary enormously. Not all students respond positively to the same teaching techniques. Not all students respond positively to the teaching techniques that we respond to when we are learning. Does your teaching style match the preferred learning strategies of your students? If not, could you change it? Do you know about the preferred learning styles of your students?

Used well, learning technology can help turn the learning environment into a highly interactive, stimulating world where the student is totally embedded in the learning process. Learning technology can offer students control over their learning, and flexibility, so that they can learn in the style that for each individual is the most effective. The ideal package will offer both a highly structured route of study for some students, or the opportunity to explore topics in any sequence which is practical for the subject being studied.

"I explain it my way, then we use the computer. Some students understand me, and the computer reinforces the concepts; other students find the computer helps sort out what I was talking about in the lecture."

Possible ways to integrate LT into your teaching -

Use LT as an illustration/demonstration within lectures - use the computer to demonstrate a particular process. This is especially useful for processes which are naturally very slow or very fast, for viewing processes from a different perspective. Use of LT can save lots of hand-waving in explanations, or the construction of awkward diagrams covered in coloured arrows - and it makes things much clearer for the students!

Use LT as an illustration/demonstration within tutorials - Additionally, using a demonstration within tutorials can allow students the opportunity to run the example several times, perhaps with the lecturer directing the students to record, or otherwise investigate, particular features of the process.

Use LT to simulate a business environment - There are a number of business 'games' available which can model a real environment. Students can role play different responsibilities within a company, and can experience conflicting interests and arbitration processes. Encourages active learning by experience and participation, rather than by absorption from the lecturer's experience.

Direct students to use LT as a self study resource following lectures - A tutorial package can allow students to work through complicated ideas at their own pace, if necessary working through some sections more than once. Most packages include self assessment questions and feedback designed to support the student and provide a clear indication of progress and understanding.

"*Often lectures can be rather dull. I've never seen a student fall asleep in computer labs, and they definitely ask far more questions"*

Possible ways to integrate LT into your teaching -

Use LT as a lecture substitute - particularly for introductory materials, or for straightforward content, a computer may be a very satisfactory delivery tool, leaving the contact time with the lecturer to be used to concentrate on explaining difficult ideas, or the promotion of discussion.

Use LT as an analytic tool - Involve the student in the process of learning. Rather than telling them what happens in certain situations allow the students to discover for themselves.

Use LT to prompt discussion in seminars - Use the computer to work through a number of different scenarios to highlight differences of opinion, or surprise results. Use the computer as a tool to record opinions from a group on an issue where they may be reluctant to record views more openly. Use the computer to compare individual revisions made to a document by a group of students.

Use LT as a resource for project work - there are many databases and other programmes full of information on a complete range of academic subject areas. Students can access the information easily, and the information need not be restricted to text or images; video and sound files are increasingly included in multimedia packages.

Encourage the students to use LT as a presentation tool - involve the students in using the technology and creating effective and professional presentations, such as producing OHP slides from WP or graphics packages, desk top publishing publicity materials (perhaps in colour, if facilities permit), or using full computer presentation packages. Such skills are increasingly sought by employers, and most students find it satisfying to produce a high quality product, often investing a great deal of effort in the process.

"Even a lot of full time students are now working, so sometimes it's difficult to arrange for times to get together. CAL packages offer tutorial support at times that suit the student; and they are always available for revision."

Possible ways to integrate LT into your teaching -

Direct students to use LT as a self study resource to prepare for lectures - Have a lecture schedule detailed well in advance, so that students know what is to be delivered in each class. Tell students that the class will assume that they know about a certain topic, and that a quick revision of that is available from a specified source. Make sure that the students know that you really do expect them to use these materials - don't go over them in class, except to sort out any problems.

Direct students to use LT as a revision resource - Computer based materials can deliver course material, supported by explanations and interactive demonstrations, where appropriate. Many students appreciate the inclusion of self assessment questions to give them some guidance as to their progress. Prior to examinations it is possible to provide practice questions and solutions for students. Many students like to study during 'antisocial' hours, and wherever possible access to computers should be arranged to take account of this. Use a diagnostic test to identify areas of weakness for individual students, and follow this up with tutorial materials (not necessarily just computer based) specifically identified to address those areas of need.

Use LT as a communication tool - Use e-mail to pass on administrative details to your students. Set up electronic seminars, rather than traditional group gatherings. Each student in turn submits a paper, by e-mail to the group, and then other students submit comments on that paper, with an electronic discussion following (it may be necessary for staff to act as a catalyst for this process). After a couple of weeks, the original student resubmits the presentation, including a summary of the discussion.

Use LT to give students immediate feedback on their understanding - computers give immediate feedback on interactions, whether these are presented as part of the navigation and selection process in the package, or as summative questions to check on progress. Well designed packages offer individualised feedback appropriate for the action that stimulated it, rather than a bland message designed for all occasions. Feedback from students indicates that self assessment questions are a very popular part of most computer based learning packages.

"It seems wasteful for me to spend my time teaching straightforward ideas, that the students grasp immediately. If I deliver the straight forward material using a computer, then it means that my direct contact with the students can be spent exploring the difficult ideas, and trying to sort out their misconceptions."

Possible ways to integrate LT into your teaching -

Use LT as a tutorial substitute - particularly for the delivery of materials that students usually have little trouble assimilating, or have studied previously. Students can elect to work through these

materials alone, at a time which is convenient to them; or together in groups with a lecturer or other demonstrator present. In this situation the lecturer can develop and expand on the ideas introduced, and clarify any confusion or misunderstanding that arises. It may be necessary to provide printed support materials, so that students can record results, or to provide them with a written reminder of the tutorial.

Use LT as a diagnostic tool - Use of a properly designed and tested diagnostic aid can help in identifying those areas of the syllabus that students already understand well, and those where there is a need for more explanation. This additionally enables the lecturer to identify any sections of the course that there is no practical need to teach at length because it is already well understood. The class may show a fairly consistent profile, or individual needs may differ greatly, but this can be readily established with a diagnostic test, and appropriate action then taken, the provision of individual programmes of study.

"I haven't got the resources to let the students try all the experiments that I would like to, so we have included a few simulations this year. They let the students experience the process of the extra experiments without stretching departmental resources, and the students seemed to like them."

Possible ways to integrate LT into your teaching -

Use LT to substitute for practical work - Some experimental situations may lend themselves to the use of simulations. A computer workstation can be used amongst a series of 'wet' laboratory stations, perhaps releasing equipment for other purposes, or relieving a difficult classroom management situation. Groups of students can work together, or students can be directed to work through materials alone. Computer based practicals can easily be made available for students to use again after the principal use, for revision or consolidation purposes.

Use LT as a simulation for experimental situations - Computers are particularly useful in the exploration of situations which are dangerous or otherwise difficult to recreate in a normal laboratory or classroom situation. Simulated experiments can facilitate the students' experimentation with parameters and variables which would normally require close supervision, and results can be automatically recorded if desirable.

Skills training as your motivation to use LT

Most employers reasonably expect that new graduates have a working knowledge of computers and their role in a modern working environment. Some jobs demand a thorough knowledge of particular types of package, others require a general level of computer literacy. The computer can also be used as a tool to develop skills of collaborative working, or equally to encourage students to take more responsibility for their own learning. Perhaps you, as a member of staff, are keen to develop your own skills in the use of and management of technology.

Encouraging students to work collaboratively can have the added benefit that students will ask each other questions that they do not feel able to ask you - and explaining things to each other is a great way for students to discover what they understand and what they just think they understand.

"Databases are fundamental to the job these days. Students must be fluent in their creation, applications and management."

Possible uses of LT -

Teach the students to use a specific package - word processors, spreadsheets and databases are all standard tools. The skills required to use any one package are very closely matched by those required for alternative packages, and are therefore highly transferable.

Use LT as a presentation tool. Teaching materials created and stored electronically can easily be accessed, updated, and tailored to individual course variations. Materials prepared electronically typically look fresher and give a more professional impression to students, and colleagues. Unless staff are seen to be making full and effective use of the available technology, students cannot be expected to do so.

"No one ever really makes backups until they have lost something that was important to them. Students have to be encouraged to use computers on a day to day basis to really learn about the reality of the electronic age."

Possible uses of LT -

Insist that all assignments are produced with appropriate tools. Emphasise the importance of presentation for a professional approach. Spell checkers mean that all text should now be free of spelling errors. Encourage the use of charting packages or desk top publishing as appropriate, but considering the practical problems of student access to equipment. Make the students get to grips with using the computer as a day to day tool. Let them learn how to refill the paper, and change print cartridges. Help them to become familiar with the advantages of using sensible file names, and to label and date discs - the only successful way to really learn these things is through personal experience.

"More and more team working is an important skill. The computer can be the focus for a group activity, and thus the catalyst for the development of effective group skills."

Possible uses of LT -

Encourage students to support each other and help sort out minor technical hitches. Sometimes students are more willing to, or find it more convenient to seek assistance from their peers. For students from whom help is requested, the process of formulating a clear explanation can help identify any areas of confusion that perhaps they would otherwise have remained unaware of.

Business simulations are a fun way to model a commercial environment, and actively promote consideration of the kinds of interactions that exist in most workplaces. An element of competition can be introduced between different groups to increase motivation.

"A lot of our students have access to computers away from the campus. We have been setting assignments that depend on material delivered by computer but the students choose when and how they complete the task. It makes them much more responsible for their own learning."

Possible uses of LT -

Use e-mail to administer your courses. Remind students of assignment deadlines a couple of days before they arise. Circulate information about room changes to all students, regardless of the campus or building in which they are usually based. Distribute assignments electronically, and ask for them to be submitted by e-mail - identifying each assignment with a date and time of submission.

Use LT to train the students in a particular skill. In some subject areas, (e.g. psychology) students are required to record observations, typically behaviours, as they occur. Use of computer simulations can give the students practice, and can immediately compare their recorded observations with the true pattern, until the desired degree of accuracy is achieved. Students can practice for as long as is necessary. A familiar, but basic example of this idea is a typing tutor, which records accuracy and typing speed, but there are now many more sophisticated applications of the same idea, some of them in very specialised applications areas.

Other types of motivation for your use of LT

Teaching Quality Assessment exercises are now familiar, and can be a factor in encouraging departments to consider the possibilities of learning technology more seriously. It is a potential danger with an assessment looming that the introduction is less thoroughly planned than it would be in an ideal world, and if this in turn leads to a few slightly (or highly) negative reactions then problems may be hard to shake off - first impressions still tend to stick.

"Students like practical classes; every year their feedback forms ask for more practicals."

Feedback from students for courses where technology is highly integrated and embedded into the course indicate that it is generally popular with students. Use of technology can add a modern feel to an otherwise old-fashioned course.

"It'll give me more time to ....."

The introduction of technology may allow you restructure your use of contact time with students or it may redistribute the times in the session when you feel under greatest pressure, but staff, or institutions, who view technology as the wonder tool to release major tracts of time, previously used for teaching are likely to be disappointed.

Technology can be a wonderful supplement to a course. It should not be expected to be the answer to every situation. Sometimes a non technological solution may even be better!

What are the course aims?

Is the course that you are delivering really matching the documented aims? For every lecture and tutorial can you identify which aim is being addressed? Which parts of the course do students struggle with? Are those parts essential to meeting the course aims? If not, why are they included?

Planning the introduction of technology is a long process. By all means tell the students that the package is loaded on the machine cluster in lab B3, but they will never use it. Any learning technology MUST be fully embedded and integrated with the wider course.

Does the content of the technology closely match with the aims of the course? If not, can it be tailored to do so? (Or should the course be revised ?) Does the technology promote an appropriate depth of learning ?

Many packages are designed to be tailored by an individual institution or an individual member of staff. Any one with a standard familiarity with computers should be able to change the examples in these packages, so that they refer to the local area or the appropriate context for each class. Don't rule out a package because there are one or two features that you don't like, if you think that the overall approach matches with your course and your objectives then it may well be possible to tailor it into a perfect fit.

What does technology offer that other resources do not?

What is the introduction of technology going to add to the course?

You must be able to answer this question, otherwise you should question the merit of going ahead with the introduction of a new item of Learning Technology.

There are lots of possible answers, these are just a few :

"The students can each work at their own pace"

"Students can use the computers at a time that suits them"

"The computer allows experimentation so the students can try things out"

" IT can demonstrate effects that are normally too hard to see"

Additionally technology assists in the motivation of students, particularly by involving them interactively in the learning process - see chapter 9.

What extra benefits can be anticipated?

What are your own aims for introducing the technology? Looking back through the earlier sections in this chapter how many other aims would be of interest to you and your students?

And the down side....

There are important words of caution. Practical issues to do with implementation are discussed in more detail in chapters 8 and 4, so just a few points are made here. Perhaps some of the most important issues can be listed as:

High initial effort required to plan implementations

Provision of adequate resources and access to computers

Technical Support for students (especially out of regular hours)

Updating of software

Attitudes - of colleagues and students

So how do I actually get started?

Planning an implementation is not a quick job. There is an initial enormous demand on your time, but a well planned implementation can repay it all eventually. Allow far more time than you can ever imagine needing.

Start with your course, and look at the aims and objectives.

Identify parts of the course that would be enhanced with the use of technology.

Identify items of technology that will satisfy these needs.

Check whether the technology can be supported in your institution - this includes things like whether it will run at a satisfactory speed across a network if all your students are using it together.

Check whether it is necessary to approach course boards or validating bodies before making changes to the course, or to the teaching methods employed.

Check whether the technology is likely to be appropriate for the skills of your students.

Identify what role the technology is playing in the course. Plan any supporting documentation or other support materials that will be required.

Identify how the students can get help with the technology, when they need it.

Plan any tailoring of software that is required.

Why will the students be motivated to use the technology? Plan any introductory sessions.

Pilot the use of technology with a small group of students and replan your implementation in light of the feedback.

Plan an evaluation of the implementation.

Enjoy it.

6: Using learning technology to support student study skills

Jen Harvey & Helen Watt

Introduction

Over the last decade there have been many changes made within the Higher Education System, for example, the creation of new universities, the growth in the number of students gaining a university place and the increased availability of learning technologies. These changes, in combination with various internally and externally directed academic audits and quality assessment exercises, have resulted in many academic staff re-evaluating the instructional methods utilised within their courses and how these relate to the quality of their students' learning. High unemployment has also resulted in many perspective employers being able to redefine the range of skills, such as good communication and team working skills, which should now accompany the body of knowledge required from a university graduate.

As a consequence, universities are now tending to provide a broader range of instructional methods but at the same time students are also expected to undertake more independent learning. Many students starting university do not always possess the pre-requisite skills to cope with the challenge of the new and changing learning environment. An environment where they are expected to study without being told specifically what or when to study. Ultimately, their success or failure within university courses can be determined by their ability to adopt the most appropriate strategy within a particular learning situation. This might, for example involve working within a group to prepare an oral presentation on a given subject or studying for a multiple choice question test. Each requires a different set of skills. With many courses having their intended outcomes as being the development of higher level cognitive skills, such as the ability to think creatively or to be able to analyse or synthesise new information etc. course designers are now considering ways in which students can be encouraged to adopt a more active approach to their learning in order to undertake learning of a higher quality. This can involve not only considering the way in which the course is designed but also the level of study skills support provided for the students.

Quality in learning

There has been a considerable amount of research work carried out to investigate the impact of students' approaches to learning (eg. Pask, 1976; Ford, 1985; Nisbet and Shucksmith, 1988; Laurillard, 1988;) At the most fundamental level, researchers have described student approaches as being within two different categories, both of which relate to a student's intent to learn. The first can be considered to be a 'transformational' approach when the student sets out to understand any new material which they then actively relate to their previous knowledge and experience. The second approach is considered to be a 'reproductive' approach. Here the student does not make the effort to understand any new material and they simply comply with course requirements in a fairly routine way. This results in information remaining disjointed, unrelated and if necessity arises, subsequently being passively reproduced.

The most frequently cited descriptions of these two approaches in the literature are the 'deep' and 'surface' approaches as identified and described by Marton and Saljo (1976 a and b) but there are similar distinctions (of intent to understand) in the 'comprehension' and 'operation' approaches described by Pask (1976) and the 'holistic' and 'atomistic' approaches described by Svensson(1976). There is evidence that when each of these approaches is used exclusively, different types of learning occur (Marton and Saljo, 1976; Pask, 1976; Biggs, 1979). Research into the consistency of these approaches has produced contradictory results. However, it has been shown that students will generally adopt reproductive approaches to their learning if an instructional method is perceived as being threatening, uninteresting, irrelevant or if their workload is perceived as being too high or they are unsure of what is expected of them, for example in an assessment procedure (Ramsden, 1984; Saljo, 1982; Entwistle et al., 1989).

Several investigators have also recognised what is described as a strategic approach adopted by some students. This approach is not so much related to a students intentions to learn the material but to the way in which they

feel motivated to work the educational system either because they wish to obtain success at university or they have a fear of failure (Miller and Partlett, 1974, Biggs, 1982)

There are several questionnaires available to measure learning strategies, the best known of which are Entwistle and his colleagues' 'Lancaster Approaches to Studying' (Entwistle & Ramsden, 1983 and Entwistle & Tait, 1992) and Biggs' 'Study Process Questionnaire' (Biggs, 1987). These can be used to help to identify students who might be 'at risk' and might require some additional support in adapting to life at University.

Why offer advice about studying?

The following extract from Appendix A of the Report of a Working Party of the Committee of Scottish University Principals entitled Teaching and Learning in an Expanding Higher Education System clearly addresses this question.

> "Skill in learning and studying*: If there is to be increased emphasis on independent learning in higher education, it is essential that students are carefully prepared for that independence. Students are currently dissatisfied with the help provided by higher education institutions in preparing them for the study skills they need (Wall* et al*, 1991). Many students seem to be unsure how to handle the amount of freedom they are given in higher education, and even how to take lecture notes or to research and write academic essays. Many institutions provide a brief initial introduction to study skills, but it is unusual for them to provide subsequent systematic advice and support. Lack of study skills support has been identified as one of the reasons for drop-out or academic failure (Biggs, 1987; Meyer, 1992). Thus, improvements in the cost-effectiveness of higher education depend, in part, on ensuring that students develop adequate skill in learning and studying. There is accumulating evidence that early failure can, to some extent, be avoided by early identification of students 'at risk'. Questionnaires have been designed to indicate the extent to which students are following effective study strategies. Students identified as 'at risk' can then be offered advice and remedial support in study skills (Entwistle* et al*, 1992)." (CSUP, 1992).*

Appendix A of the quoted report above reviews the extensive literature on student learning and teaching in higher education, therefore it will not be duplicated here. This taken together with the series of self-instructional materials "Effective Learning and Teaching in Higher Education" produced by the CVCP Universities' Staff Development and Training Unit in 1992 and the examples of both traditional and innovative good practice found in "Guidelines for Promoting Effective Learning in Higher Education" (Entwistle et al. 1992) can provide some background reading on this research.

Learning Technology and developing study skills

Improving study skills is an area which everyone agrees is important. Unfortunately, because this type of training often is not the responsibility of a particular individual, module or department, training in these essential skills can sometimes be neglected. In a crowded timetable course organisers are often reluctant to transfer contact time from subject specific content to more generic material such as study skills. It is not surprising, therefore, that a number of resources including several LT materials are now available which enable students to spend as much time as is necessary for them to acquire the necessary skills without impinging too heavily on staff-student contact time. In some institutions, information on study skills is included in induction training or in freshers' week.

Some of the best computer-based packages which provide tips and techniques for students to improve their study skills were developed under Phase 1 of the Teaching and Learning Technology Programme. In particular:

- Teaching with Independent Learning Technologies (TILT) (Project 1) which has developed a number of hypertext Information Skills modules and a Study Skills module aimed mainly at first and second year students;
- Identifying and advising students at risk from deficient study skills; a computer-based package for departments (Project 8). PASS: Personalised Advice on Study Skills containing three pieces of software: Questionnaire, StudentView and StudyAdvisor;
- Courseware for Learning and Study Skills (CLASS) (Project 10) which has open access modules, focusing on the acquisition and practice of generic learning and study skills;
- Technology based learning in medicine; beyond courseware (Project 31) which aims to promote the incremental development of a transportable technology based system of learning in medicine.

Further information on these and other packages are available in the LTDI Information Directory.

Thinking about study skills training

Although there are an increasing number of CAL packages, and other LT materials, available which can be used to smooth students' transition both into and through their time at university, it is still important for these materials to be integrated into courses rather than just being made available should students wish to obtain advice or assistance. Often, study skills such as time management and examination skills are timetabled in sessions during an induction or freshers' week when students might be referred to booklets or LT materials available on departmental or university networks which will be available to students at other times during their period of study. Holding an event such as this at the beginning of the academic year may not be the most effective time as students may not appreciate the relevance and importance of the advise on offer. During these first few days in higher education it is perhaps difficult for students to imagine what it might feel like, for example, taking notes from a lecture or to have the pressures of meeting several assignment deadlines. Further revision or exam techniques will only become uppermost in students' minds as they are approaching their first class test.

Lecturers and class tutors can assist students by integrating relevant parts of the study skills materials at various stages throughout the session. Students should be introduced to the material available in packages and provided with the necessary information on how to access them. For example, when students are given an essay assignment they could be directed towards study skills materials on essay writing. Thus students can refer to the various sections included in the package as and when required. Students are more likely to be motivated to use the facilities when the relevance of the content has been highlighted by integrating references to the available material in everyday course work.

Targeting the students who need help

If the option of whether or not to use a package is left to students it is often the more conscientious individuals that are the ones who make use of it. Students who are having difficulties will often select to write up notes or revise subjects they are having difficulty with rather than spend the time working through LT materials on how they might improve their examination skills. Unfortunately, deliberately targeting or identifying only some students at risk can attach a stigma to obtaining advice and study skills becomes perceived as only being necessary if you are falling behind or not coping with your course. Timetabling in a one or two hour slot per week for study skills training also has its disadvantages in that study skills become almost compartmentalised with some students failing to see the practical application to the rest of the course.

If study skills training is integrated into the subject based modules this can help to alleviate many of these problems. For example, running a session on how to make a student group more effective in association with setting a group based project can lead to students beginning to think of study skills development as being as much a part of the course as undertaking the course assessments. Make the training an enjoyable experience, involving the whole of the class and students are likely to feel more motivated to think about how they might adopt a deeper approach to their learning by improving a broad range of study skills.

Timing and assessment implications

Another important consideration when planning to integrate study skills teaching into courses is to time the integration phase appropriately. Too early and the training will not seem relevant - too late and most of the material will appear redundant. Integrating the use of Learning Technology and CAL study skills materials into courses also means that examples of good study skills should be rewarded academically in some way within course assessments. Therefore, if you are trying to encourage students to improve their group skills marks should be allocated for this, usually through some kind of peer group marking scheme, in addition to that awarded to the subject content.

Some ideas for integration

The following section provides some suggestions of ways in which Learning Technology can be used to introduce specific study skills more effectively into courses.

Involving students in student induction

Encouraging an active student participation in developing study skills can be a productive way of helping students to take responsibility for their own and to assist in other students' study skills development. For example, new students can be adopted or mentored by students further on in the course. This can also be a useful contribution towards the induction process for students starting university. If group 'mentoring' sessions are supported departmentally by being timetabled into courses then this will increase their perceived usefulness and importance. If a formal adoption or involvement is to be made by other students then perhaps some kind of incentive could be used to encourage the student's participation. This could be some kind of monetary reward or involve a formal academic accreditation as used in various Supplementary Instruction projects.

Some other ideas for student involvement could include :

- Give second and third year students the responsibility of providing information to new students about, for example, computing facilities in order to introduce a different perspective to that of academic staff.
- Involve students in writing a beginners guide for new students about finding your way about the World Wide Web.
- A list of Frequently Asked Questions posed by new students could be set up on a University computer network which relate to different study skills and these could be answered by both staff and other students.
- Computer based help line or e-mail discussion group could be set up for new students.
- Video clips of different scenarios which new students might encounter during their first weeks eg tutorial, lectures etc could be stored in association with files or pieces of CAL software providing advice in, for example, note taking
- Student teams could be set up to function as study groups to provide mutual support for each other through the first year. Study groups could be maintained in subsequent years via e-mail or using conferencing software like First Class. Setting up student teams can also provide the opportunity to reflect and work together as a group if, for example, students are encouraged to submit reflective diaries.

Note taking

Faced with the large quantity of information covered within a lecture, some students can have problems in taking notes from lectures either because they have difficulty in recognising key points or they are preoccupied with trying to write down everything said. Referring students to LT materials which provide advice in taking notes eg PASS is more useful when supported by the member of staff making it clear which are the most important points from their first lectures. Using management tools (for example the computer based Pharmacology Integrated Learning System which provide the software to present lecture notes, links to LT materials and assessments) can allow staff to provide their students with a basic framework of information about their lecture course and also encouragement to look for links between different parts of a subject. In addition :

- Students could practice taking notes from a video of a lecture and make comparisons between their own and others notes and use this to provide a trigger for discussion.
- Student support teams could be encouraged to share their notes
- Students could be encouraged to think of ways in which they might rewrite their notes making use of various learning tools such as concept mapping software or developing a multi media package with links to relevant WWW pages
- If the lecturers own notes are made available on the departmental fileserver, then students could compare their own notes with that of the lecturer and score themselves according to the number of main points which they have identified. These could then be compared with the rest of the class' scores.

Groups

LT materials which encourage students to reflect on their group dynamics can be used as part of an introductory session when setting up student study groups. This could be followed by students being asked to reflect on their groups activities or to keep a diary of their work on a particular project. Proposed group plans or a synopsis of

the plans or reflective diaries could then be submitted electronically to the lecturer and comprise part of the project assessment.

Some other ideas for group based study skills activities might be :

- Student groups could work through the PASS Study Advisor and compare their responses within their group. Possible solutions as to how students might solve some of their problem areas could be used as a trigger for a class discussion.
- A group game over a sequence of weeks relating to study skills could help to share their experiences. This could be computer based with regular feedback sessions to the rest of the class.
- Groups of students could be asked to construct a concept map of a particular subject area using the CLASS auto-monitoring software and comparisons made between each of the groups different concepts maps, including the ways in which they have linked up ideas.
- Groups of students could review different pieces of software and report back to the class. For example they could pick out one of the CLASS study skills modules and carry out some of the recommended exercises and report back on their effectiveness.

Examination skills

The CLASS, PASS & TILT packages provide useful information on examination skills however, providing students with practice assessment material can be a useful way of applying these skills within a non threatening environment. Providing students with feedback on their performance through such methods can be a useful way of assisting in the learning process.

Different pieces of software are available which can be used to provide students with a range of different types of assessment (see Chapter 10) and these can also be used to provide students with constructive feedback on what constitutes good or bad answers or how to go about answering particular types of questions. Students could also be encouraged to devise their own questions to add to a database or to contribute to an ongoing discussion via e-mail.

Writing skills

Although general advice can be given to students via LT materials as to writing essays or laboratory reports, individual staff often have individual preferences as to the presentation of materials and the way in which they mark assignments. Again this reinforces the idea of providing students with guidelines as to what will constitute a high or low scoring assignment for their particular subject. Using LT material as a foundation, a lecturer could point out the good and bad points within anonymous examples of previous students' work, possibly from work stored within a departmental computer based resource collection. Added comments or notations within a piece of word processed work can provide constructive advice to a student as to why, for example, they have consistently obtained a low mark for their own assignments.

Some other ideas for developing writing skills :

- Ask students to write out a set of instructions, for example, relating to carrying out computer simulation, and ask another student or a group of students to follow them through and to make comments.
- Involve students in developing a computer based scoring grid for use when marking essays and then ask them to use it to mark another student's essay or to self assess their work . Involving students in deciding the weight between different scoring criteria can be a useful trigger for discussion with a class which has just been set a course assignment.
- A selection of computer based material from various publications could be made available for students and form the basis of a quiz when students could be asked to identify the source of a piece of text and to justify their decision.
- Students could be asked to write a paragraph about a specific subject area in a particular given style eg for a tabloid journal, a woman's magazine or a learned journal and the rest of the class could be asked to guess the intended audience.

Retrieving Information

Students are now able to obtain information from a variety of sources. The World Wide Web provides access to, for example, academic libraries, multi- media databases and discussion groups from which individuals can obtain a range of up to date information for use in their course work assignments. However, instruction in methods of carrying out effective information searches is important if students are going to move away from using just their lecture notes or perhaps only one course book as their main sources of reference. LT materials which provide outlines of efficient ways of carrying out literature searches such as the TILT software can be used more effectively if used in conjunction with face to face sessions involving the subject based librarians and at an appropriate stage of the course. This helps not only to identify the relevant person from whom a student might seek assistance in the future, but also helps students to relate the information to their own particular institutional environment.

Some other ideas to encourage students to make use of computer based information retrieval systems might be:

- Students can be directed to the World Wide Web as a source of information. Ask the students to recommend useful URLs and use these to build up a departmental Resource base for future students' reference.
- Setting a collaborate project where a group has to give a presentation to the rest of the class about a topical subject but each group member researches only one specified part of the topic. The group work is then dependant on each of the student's contributions.
- Ask first year student groups to retrieve information from the library about a topic and to present their finding on a poster which could then be assessed by the rest of the class
- Students could be asked to prepare an assignment which uses only the World Wide Web as a source of information and has to cite the URLs used in their reference list.

Conclusion

If students are to be expected to be motivated to undertake an active and meaningful approach to their learning then they should be provided with both an appropriate environment and adequate support . Much attention has been focused on which teaching and assessment methods would encourage a deeper approach to learning. However, Entwistle et al. (1991) have suggested that what is important is not so much what students are doing within the classroom but what the students are doing outwith the classroom, in terms of their study methods and study behaviours. Students are more likely to take responsibility for their own learning and to become more autonomous learners if adequate support is available at suitably timed stages of their course and they are rewarded appropriately within the university's assessment procedures.

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7: Choosing courseware: Some guidelines to first step evaluation.

Jen Harvey

Introduction

With the growth in the use of Learning Technologies and the availability of more Computer Assisted Learning Packages, an increasing number of people have started looking at new pieces of software with the aim of perhaps using the material in their teaching.

What do you look for?

Faced with a new piece of software which someone has recommended to you or hunting for a package which would mean that you won't have to teach that boring part of the syllabus for the Xth time; you probably have some idea as to exactly what your software requirements are. But what aspects of the software are important in the learning process? What features do you look for? Often the 'intuitive approach' is the process adopted and a first look at software reveals whether or not the developers have tackled a subject in the same way as you would or you feel it should have been tackled. But this type of approach does have some limitations: can we predict how students will respond to the material when used within one of our courses or how much the way in which the software is used will influence the quality of the learning outcome.

How do you go about evaluating a new piece of software?

When considering whether or not to use a Learning Technology (LT) materials, it is recommended that you carry out a full evaluation study prior to the implementation of a new piece of software within a course (see chapters 11 &12 for more details). A full study would normally comprise:

- a first step evaluation by staff, like yourself and colleagues
- an evaluation with students
- a full evaluation as part of a course

This chapter deals with the first step evaluation: How do you decide whether or not a piece of LT could be used to support your teaching? The process is not dissimilar to that used when selecting appropriate textbooks for a course and in the same way, you might decide to use only some and not all parts from a software package. This section begins by reviewing a number of different ways of beginning to carry out a first step evaluative study of your own.

Evaluating Computer Assisted Learning Material produced by Durham University as part of one of the TLTP projects (IT in teaching and learning: a staff development pack) provides a useful structured way of helping you through the various steps involved in prioritising which aspects of a CAL package/LT materials are the most important. In summary, they recommend that you think about which aspects of the package are important for your particular needs and use these as a basis for a checklist which can act as a guide when you look through the package in a first step evaluative study. The four different aspects which Durham University suggests are:

- **subject content** and the way in which the material is structured
- **usability** or the level at which a student is able to work through the package without help, in terms of on-line feedback and support
- **pedagogy** and the quality of the approach adopted by the package and how it encourages quality in learning through, for example, the use of assessment
- **layout** and the stylistic presentation of the material within the package.

Each of these four aspects can be subdivided into categories depending on the emphasis which can be placed on them within a given context, for example, text, graphics, colour and fonts would be considered when reviewing the layout.

Consideration will also have to be given to resource availability and necessary hardware specifications for the courseware being considered. These aspects are not covered in this chapter, see chapter 8 for more information on this area.

Learning Effectiveness

Learning effectiveness, categorised under pedagogy in the Durham study, is probably one of the main priorities when considering whether or not to use a piece of LT, for example: Does the material provide an effective way of teaching this part of the course? Does the package encourage the attainment of your course aims and objectives?

John Milne (1995) from the CTI CLUES has used the model first described by Phil Race (1993) as a basis for carrying out evaluative studies. This approach considers the effectiveness of the learning environment and whether or not how each of the stages of the learning process are encouraged within LT materials. Phil Race's model describes the process of learning as requiring an individual's desire to **want, do, feedback** and **digest**.

- **Want** relates to the level of motivation to use the package.
- **Doing** is the level of active participation involved.
- **Feedback** is the level of learning support provided by the package.
- **Digestion** relates to way the student can make the material their own.

The learning effectiveness of a piece of software can then be measured by how well these features are supported within the CAL package/LT materials. However, whatever model is adopted it is the level at which the user becomes actively involved with subject material which will determine how much learning is undertaken. The more active the approach encouraged, the more likely it is that learning will take place.

Thinking about Integration?

Just picking out different aspects of LT materials, unfortunately, can encourage an approach whereby features are considered in isolation and not holistically within the context of a particular course. The way in which the software is integrated into a course is one of the most important factors determining learning effectiveness. An integrative rather than a 'bolt on' approach also encourages the students to feel that the LT material is relevant to the course, especially if they are to be assessed on the material. Providing additional support or embedding the LT materials within a series of classes are also useful methods of integration. For example, if adequate support is not provided from within the package you might decide to have pre or post classes in order to introduce the subject or to draw it all together retrospectively. Alternatively, you might use the material in a tutorial, set a group task and provide students with a handout which provides them with additional assistance.

A First Step Evaluation Checklist

I have produced a draft checklist (the "First Step Evaluation Checklist" in the appendix) which takes into account a range of aspects which you might like to consider when carrying out a first step evaluation. These include the learning effectiveness, usability, presentation and content of a piece of software. The checklist aims to give some pointers as to what you might consider as you work through a piece of software. It takes into account both of the evaluation models discussed earlier. What you select to use will be dependant on your own perceived requirements and in some cases you might feel that these categories are not applicable.

The following material is included to provide a background to each of the sections included in the questionnaire and to suggest some ways in which you might integrate the software into your course.

Part 1 - Some points to consider as you work through:

These are in the form of leading questions to bear in mind as you work through the package and to how the material might be integrated into specific courses: What background knowledge or additional support would be required by your students if they were to use the package? How do the learning strategies encouraged in the software fit into the rest of the course in which you plan to use the material i.e. if a problem based approach is used throughout the rest of a module then asking students to go through a sequence of factually based modules might be perceived as being inappropriate by students.

Suggestions

At first appearance, a new piece of software might explain a process through the use of an excellent simulation, but does not provide an appropriate context for the material. Used as part of a lecture where you provide relevant additional material, this could be a more effective way of explaining the subject than using a static graphic. If only parts of different packages are suitable why not set up a resource folder of material on a local fileserver which students can access for reference for coursework or to aid in their revision for assessments.

Part 2 - A step by step guide

Introduction - first impressions of the package

What can I expect?

The introduction to a piece of software/LT material is important in that this can be the first time that a student might have been introduced to a subject. Providing an initial framework, acts as an advance organiser and means that any new material can be added to this cognitive framework in a structured way. In turn, hopefully this deeper or more effective processing of the information should allow a more efficient retrieval at a later date. If material remains unlinked to the student's existing background knowledge and the student is not encouraged to take an active involvement when using the LT materials this is likely to result in a surface type of processing where material remains unassociated and unrelated and ultimately less memorable.

Clear aims and objectives set out within the introductory section are helpful to the students as they clarify exactly what is expected of both them and the package. These are also helpful to you for ascertaining the level of the pre-requisite background knowledge as well as allowing you to rectify any shortfalls by providing any necessary additional supportive material.

Suggestions

You can always provide your students with your own module aims and objectives in the form of a handout, this is particularly useful if you want students to refer to only one section. Providing leading questions can also assist in the process of learning by encouraging students to adopt an active approach. These can then be used as the basis for a feedback session in a tutorial with a group of students.

How is the material to be presented to the students?

In many packages, the introductory screens include a map or a menu of the subject areas to be covered. The way in which this is presented on screen can pre-determine the way in which the subject is perceived. For example, presenting material in unrelated sections in a linear type format could result in material being perceived as unrelated 'chunks' of information. Providing a fixed path through the material for students to follow limits a user's feeling of control and the level to which they might be able to use the package in a way which suits their individual learning style.

In addition, when you are looking at a piece of software for the first time, it is important to stop and review the LT materials at different stages and make sure that there are no gaps in the subject content or that relevant or important information is omitted. Sometimes if you are close to a subject area it is easy to skim through a package and not notice gaps in the subject content or whether there was a lack of appropriate student support.

Suggestions

Running pre and post LT sessions with students can assist in the quality of the learning experience by setting the context and encouraging the integration of the subject areas. For example, laboratory simulations might become more meaningful if preceded and followed up by practical exercises in the laboratory.

Lack of familiarity of working with computers?

Some students can feel threatened by having to use computers if they are using them for the first time or do not have much computer experience. Providing information about any menu bars and explanations as to the function of icons is important prior to letting your students loose on the package, particularly, if the icons are less than self explanatory. Often packages will provide an introductory section about what icons mean but this is not always the case. Even if your students are reasonably computer literate and could make an educated guess as to how they might proceed, if the on-line LT support is negligible, then perhaps you might like to consider providing instruction about how to use the package either in a class or in the form of a handout. In addition, you

could make sure that someone is at hand to help students who might have difficulty. You might even consider asking students from another year to provide assistance. However, it is always important to identify any perspective problem areas which your students might encounter and to draw their attention to these in advance of their using the LT materials. For example, the time taken to load a particular part of the package or if insufficient explanations or instructions are provided to some of the sections.

Mid way through

The usability of a package is determined in part, by the ease at which you can move about the software. The more flexibility the more the package can cater for an individual's learning style. On the negative side, the more a student might feel lost and not know how to proceed. Packages which enable students to go back and forwards, readily allow students to go over and to refer back to information and ultimately digest the subject matter. So it is useful to stop at different points of a package and to check how easy it is to navigate between pages and sections. Is it possible to leave the package and to go back to exactly that point at a later stage or do you have to wade through the material from the beginning again?

LT material with little flexibility built in, might require a bit more imagination as to its usage, however, it is possible to encourage interaction, by for example, introducing a group task which can stimulate interaction through discussion between students.

Simple electronic page turning packages with lots of factual material and references can result in students looking for hard copy print outs to take away for reference at a later stage. The provision of an on-line notepad within a package can be used to encourage an active engagement with the subject matter and to personalise the material, but sometimes you might have to encourage your students to make use of such a facility. Another way of encouraging students to take notes or to adopt a more active approach to a LT materials is to ask students to review or to report back on a package. This can also provide you with a useful method of obtaining feedback on the packages usability and also encourages students to feel more involved in their learning. However, more packages are now providing ways in which students might store their notes electronically, so this is worth checking out.

Package design and presentation of material

As mentioned earlier, the factual content and how material is presented are aspects of a package which perhaps would be considered almost intuitively by most people upon first inspection of a piece of software. However, it is important to pay attention to the legibility and how the material is presented on screen as this can also be influential in the way the student later prioritises the information. How are the key words identified and the main points prioritised? How do you know what is important?

Despite personal preferences for particular colour schemes, if the text which appears on screen is difficult to read or inappropriate then students are likely to lose interest and give up. In addition, consideration of the specifications of the machines on which your students are going to view the material is also worth thinking about at this stage. Although a piece of software might look excellent in a demonstration using a high resolution screen and a powerful machine, loading and using images and video clips might be less than meaningful on a slower machine.

Student support

The availability and the usefulness of student support and on line help facilities can, in many cases, determine when and how the package can be used. An excellent on line help facility can mean that students can be left to go through packages at a time which suits them. When reviewing a package for the first time, it is a useful exercise to stop at different stages and review what help facilities are available from different screens in the same way as a student might need to. How useful is this help? The most likely event if a student becomes lost and the package does not provide them with adequate help is that they will just give up working through the material, rather than trying to seek you out for assistance. It is also worth remembering to draw your student's attention to a good Help facility if it is provided from within the LT materials.

End of section summaries or quizzes can assist the learning process by encouraging students to review the material already covered and this again leads to a more effective storage of material. Cross referencing to other sections or to other pieces of software helps students to integrate and develop a deeper understanding of the information. When reviewing the package, think about how each section finishes and the next one begins. Is there any cross-linking provided?

Suggestions

An e-mail discussion group or setting up a database of frequently asked questions can provide additional support for your students. Summary sheets of the important points covered or running surgeries for students who perhaps are experiencing difficulties can be used to provide additional support.

Assessment

Assessments can be used in a variety of ways which can help students to think more about a subject and often packages include short quizzes of multiple choice questions to test a students knowledge. If assessments do form part of the LT material's learning process then the level and the type of feedback is important in determining their usefulness. Providing constructive feedback is going to be more encouraging if a student gives the wrong answer than, for example, a monosyllabic 'Wrong'. Go through all the questions and check what happens when you obtain the right and the wrong answers. What happens if you repeatedly give the wrong answer? Is this constructive help?

Suggestions

Adding a multiple choice type question file, to be used in association with the LT materials and monitoring student responses can be a useful way of determining any grey areas (see chapter 10 on assessment). If the students' marks do not count towards their coursework, including such an assessment can also help students to rehearse for a summative assessment and this will also increase the student's feeling that the LT materials is relevant to their course . Giving students questions which require them to link ideas included in the LT materials can also be used to encourage them to integrate ideas and link information together. Some packages also provide the facility to track student's progress through the material and enable you to see which parts of a package the students have accessed and how much time was spent there.

Retrospectively?

When you have completed looking through the package, again it is a good time to consider how the material might fit into your course objectives and whether or not the subject benefited from the use of the technology. Could you have taught the subject better by either using another method of teaching and/or you had used the LT materials in a different way?

Most people are unlikely to find LT materials which exactly fits what they need or teaches the subject in exactly the same way as they would, but integration of the material into a course can mean that the software material becomes a useful method of teaching a particular part of a course, in the same way as a 'hands on' laboratory session might be used to teach a practical set of skills in another part of a course.

Can you modify the package?

Some packages are written in a way which enables you to modify them, in part, so that they can be tailored more to your individual course needs. It is sometimes possible to amend examples cited in the package, assessments and/or references. This is worth considering in order to increase the relevance of the material for your students. If the possibilities for such modifications are not evident, sometimes the software developers are amenable to making the changes for you.

Postscript

Some ideas for supporting first step evaluations

- Set up a review group in your department and have regular meetings to compare notes about software (most CTI Centres provide regular information and reviews about new LT materials).
- Set up or add to a departmental newsletter with recent information about new software.
- Compile a departmental review list which could be stored on a local fileserver and which allowed you to allocate star ratings for different criteria e.g. good student on-line support, good use of assessment.
- Organise a departmental workshop and have a variety of pieces of software on show and ask people to fill out an evaluation checklist.
- Set up a departmental multi-media discussion group.

Useful sources of information

A number of papers have been written relating to the process of evaluation and the TILT and EMASHE groups of University of Glasgow have written a lot of material about the summative evaluation process. ELTHE (Evaluation of Learning Technology in Higher Education) is a useful self help group, for further information contact Philip Crompton (see Appendix 3: Contributors).

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HEFCE *IT in teaching and learning: A Staff Development Pack*, developed by a consortium of universities under the HEFCE Teaching and Learning Programme, contact Audrey MacCartan, Information Technology Service, Durham DH1 1TA

TILT *Teaching with Independent Learning Technologies Evaluation Group* led by Gordon Doughty, Robert Clarke Centre, University of Glasgow, Glasgow G12 8LS.

Milne J., (1995) 'Evaluating a CAL Package for your course', January 1995 *newsletter for the CTI Centre for land use and environmental sciences*.

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The checklist referred to in this chapter is included as Appendix 2-A.

Evaluation is also addressed in the following chapters: Chapter 11 - a conceptual introduction; Chapter 12 - A practical guide to methods, and Chapter 3 - the role of evaluation in the overall process of implementation

8: Practical implementation issues

Kathy Buckner & Greg Stoner

Having identified both a need for using leaning technology and the availability of appropriate Learning Technology (LT) materials (software/packages/courseware), consideration must be given to a variety of practical issues relating to the actual implementation. These include assessing the availability and appropriateness of physical resources and staffing, ensuring the provision of adequate student support and dealing with political and funding issues.

Physical requirements: availability and appropriateness

It is essential to ensure that there are appropriate physical resources available to you and your students within the institution where the chosen software can be run. This involves ensuring that there is hardware available in the institution that is capable of running the chosen software both for student use, e.g. in computer labs, and staff use, in lecture theatres and other teaching rooms. For student use it is also important to ensure that there are sufficient suitable computers available to your students for the class being taught and any resulting self study needs.

Computer Specifications

The minimum hardware and operating system specifications required to run a piece of software are normally specified by the software developers/suppliers. The basic systems specifications that you should check include the following:

- Basic system requirements: e.g. PC 486; Mac Performa
- Processor speed: e.g. 66 MHz
- Monitor/display requirements: e.g. SVGA; 800x600 screen resolution
- RAM: e.g. 8Mb
- Disk space required: e.g. 20Mb available on hard disk or on network drives
- Operating system: e.g. Windows 3.1, Windows 95, System 7.5.2
- Networks Supported: (where relevant) e.g. Novel, TCP/IP
- Other devices: Sound cards, speakers/headphones, CD drives etc.
- Printers supported by the application (not normally an issue in a Windows or Mac environments)

Remember that the basic specifications quoted for a product are likely to be the minimum specifications. On such equipment the software may run at an unrealistically slow speed or may require that other applications (including certain network facilities) are not running at the same time. It is therefore advisable to check that the software will run adequately on your systems before committing yourselves, even if your equipment does meet the technical specifications quoted, particularly if you are intending to use the software in a networked environment. Check for recommended specifications as well as minimum specifications, these are often a more reliable guide to the equipment needed.

It is likely that you will need to consult with you technical support personnel at an early stage to ensure that you won't have technical problems. It may be sensible to get your technical staff to speak directly to the suppliers technical staff to avoid getting involved in the technical details yourself.

Hardware or software upgrades may be needed if the current hardware is insufficiently powerful or if old versions of operating systems are in use. Network requirements should be investigated if the software is to run from a file server. If using World Wide Web or Internet facilities with students you will need to ensure that the computer lab that you intend to use is connected to the external networks and that the set-up is sufficiently robust and reliable to work with a number of students all accessing external sources at the same time. Reliability under load should be tested before the first groups of students begin using the computer lab. In most cases local computing support services should be able to assist in the specification and acquisition of computing facilities.

Remember that to use your LT materials students will probably also need, or at least want, access to other peripheral equipment, especially printers and increasingly CD drives. The physical provision of this equipment

may only be part of the problem. For example, the running costs of unregulated printer usage can be significant, therefore it may be necessary to invest in the equipment needed to collect funds from users.

Computer laboratory availability

If resources are already available in an appropriate computer lab it is worth checking that you can book the room at the times when you want to teach your students and that students will be able to get enough access to the labs outside of formal class time when it will be required. This normally means planning ahead, particularly in situations where computer labs are in high demand. Some institutions have long lead times for timetabling of computer facilities and the need to integrate computer lab bookings with bookings for lecture theatres or other teaching facilities may complicate matters even more.

If there isn't an appropriate lab available you may have to start bidding for additional resources either through departmental or other institutional channels. This may entail the preparation of proposal documents, including the development of a rationale and the specification of requirements and costings. It may be necessary to "lobby" particular individuals within the institution to get them to support your application for additional resources. Time delays can often be experienced in getting bids accepted and also in seeing these through to the purchase (large capital bids will usually have to go out to tender which will add to the delays) and setting up of labs, so planning ahead is essential.

Many computer labs are run on an open or drop-in basis and booking rooms for teaching may not exclude others from using spare machines. In some cases this may be acceptable but if you wish to discuss learning materials with the students and hold their attention the presence of other students may make this more difficult.

Clear instructions on access to computer labs should be provided to students. They need to know how, when and where they can make individual bookings. Out of hours access may also be required and security of the computing equipment may be an issue if the lab is unsupervised. Students will probably need to "sign in" if using the facilities out of hours for reasons of safety.

Consider how you, or whoever manages lab usage, is going to deal with the demand that will arise from your students, bearing in mind that they are all likely to leave their work to the last minute and then complain that there is not enough lab time. Will you attempt to ration students' usage? Is your booking system adequate to cope with students who attempt to "cheat" - booking excessively, not turning up to booked sessions? To a large extent these problems become less so if you set out the rules in advance and get the students to help you to police booking system abuses.

Computer laboratory design

Even if you don't have any influence over the design of computer labs you may have a choice of facilities and lab design can be an important issue in implementations. The factors to consider depend on the mode in which you intend to use the LT materials; basically are you expecting the students to be supervised or taught in the class or are students working on material independently. Often a mixture of these modes are appropriate for different stages in students' use, hence it may be appropriate to use different labs for different sessions.

In supervised/taught classes it is important that you are able to view the students' monitors while they are interacting with the LT materials. One way to achieve this is to provide sufficient space for the lecturer or supervisor to walk behind students while they are working on the computers. Some labs are designed with the screens embedded into the desktops at an angle which can be conveniently viewed by both the student and the lecturer. Other labs are being designed so that the lecturer can interact with the students via a console at the front of the class, similar to the way in which lecturers in language laboratories interact with their students. Laboratories can also incorporate a feature which enables either one computer display (usually the one the lecturer has access to) or any computer display (including the lecturers') to be switched to a connection to an overhead viewer so enabling the whole class to view that particular display. This facility is advantageous when trying to demonstrate a particular point to the whole class.

For independent student usage many of these considerations are less important. However, in all circumstances it is important that labs are designed with enough desk space to allow, even encourage, students to take notes and to consult any documentation that they need to use the courseware. This is often a problem where labs have been designed to fit as many machines as possible into a small space.

If you are expecting students to use LT materials on group based projects or exercises expect them to want to use machines together or to cluster together around one computer. Is there enough space in your labs to allow this and are there enough seats?

Computer availability in teaching rooms & elsewhere

Within most HEI's only a small proportion of the teaching rooms will be equipped to demonstrate LT materials or to use computer based presentation tools. Alternatively it may be possible to take your own/departmental equipment to use or to book equipment from central computer &/or audio/visual service departments. The problems will however be greater if you need a live network connection. Ensure that you make the necessary arrangements/bookings well in advance and that you make sure that you give yourself enough time to set-up and test the equipment.

Additional difficulties will arise if you intend to support student access to LT materials from computers at remote sites (e.g. other campuses or home) or from computers on different network systems. These issues are likely to require specialist technical support and pre-planning, probably on a an institutional basis.

Staffing issues and support for students

Student support and staffing requirements are intrinsically linked. Good preparation of students, materials and equipment can pay dividends in terms of the support problems encountered by you and your colleagues.

Preparing students for using LT

Advising students on how the computer based learning material will be integrated into the rest of the coursework is very important. Issuing course guides with a clear indication of how, when and where they can access LT materials will be helpful. An indication of the relevance of the LT materials to the content of the course being studied will also be helpful in creating motivation.

Students may require support in getting started with the LT materials provided. It is possible to demonstrate learning materials to the whole class either in a lecture or computer workshop using a projector or LCD panel. This will help familiarise the students with the courseware before they sit down in front of the computer and will help to allay any fears they have, as will general computer familiarisation sessions for students who have not used the type of computing environment that you are expecting them to use. Consider assessing students' IT skills on, or before, entry to a course that requires them or stating the skills requirements as a prerequisite for the course. Offer access to relevant IT skills courses to students who do not have the required skills. Here it may be possible to utilise courses provided centrally within your institution.

The better prepared students are the less they will require support later.

First-line student support

Getting this aspect right is a key element in successful implementations of learning technology. Students who don't know what to do and can't get immediate help are likely to loose confidence and interest in their computer based work and create extra demands on staff time to put things right latter. This is particularly so in the initial stages of using LT materials, and close to submission deadlines.

There are a variety of ways of providing this "first-line" support. Often the lecturer taking the class will be expected to provide this support. However, this is rarely efficient as academic staff have offices away from the labs and/or are not "there" when required. Wherever possible first-line support should be available from the computer staff who manage/supervise the labs or by others such as student demonstrators or research students. An alternative might be for support to be provided over e-mail which could save interruptions in the office, though the timeliness of support is likely to suffer.

Academic staff

Ensuring that course and/or module providers have sufficient time to integrate LT materials into their teaching can sometimes be a problem. The initial stages of implementing teaching into the curriculum can mean a fairly substantial investment of time at the outset, particularly if new or supporting materials have to be produced. Other staffing requirements on the academic side may include the need for staff development courses and the

need to train computing staff, demonstrators or research students in the use of the software and supporting materials so that they can provide adequate first-line support.

Technical staff

Technical support for the hardware and software must be provided. If students have problems or difficulties in using the LT material because of technical deficiencies they may well be put off using the LT materials and may conclude that because the technology is inadequate so are the LT materials. In many cases technical support can be provided by either central computing services or by departmental technical support services, this should be sought in advance. Technical support personnel may have to work with software/courseware suppliers if difficulties arise at the installation stage.

Technical staff are often the ideal people to offer first-line support provided they are adequately trained to deal with students' likely problems. Given the difficulty students often have differentiating between technical problems and "learning material problems" and of getting hold of academics it is often the technical staff who will be approached for first-line support in any case.

During open access sessions and access outwith normal working hours it will still be necessary, or at least desirable, to provide appropriate support to ensure the smooth running of networks, computer systems and software. If technical support is not available at such times, because of resourcing issues, this should be made clear to students so that they are aware that there may be some degradation of service.

Funding, politics and people

Funding, politics and people are all central to getting anything done within an organisation and whilst the practical issues will vary both in their nature and how to deal with them between institutions there are a few observations that are worth making in relation to the use of learning technology. Also the way that you approach these issues will of course depend on your position and attitudes.

Funding & politics

Being aware of your institutions IT strategy and the opinions of the influential people in the computing support department will help you to obtain access to resources or funding to acquire them, as you will be better able to produce a case to support your request. Further, many institutions (or devolved funding units - schools, departments, faculties) have separate funds earmarked for innovative teaching. Even if they don't, similar considerations may well be taken into account in equipment bidding procedures. Find out about the institutional structures and the funding/bidding rules, then use them to your advantage. Also be aware of external funding opportunities, there have been several funding initiatives in the UK in the past few years including, for example, TLTP & ITTI on a UK basis and UMI in Scotland.

Consider who (else) has a vested interest in the use of LT in general and if possible the LT or IT resources that you want to use. Other academics in your own field/discipline either in your own or other departments are obvious candidates. Less obvious are staff in support services, e.g.. computing service, the library and staff development or learning support departments. Some of these people may be interested in the applications or equipment directly or may be interested in the job opportunities or interest that your using the facilities will provide to them. Pool your resources to fund acquisitions &/or to lobby for the resources, interdisciplinary co-operation is often favourably considered.

Also consider the positive impact of having "your" labs full of students - it provides evidence for your lobbying for more resources.

Departmental politics & personnel

All academic departments are under pressure to teach more &/or to produce more research. In this context it is important to consider departmental politics and the attitudes of your colleagues. Often teaching is a secondary priority, therefore avoiding the efforts of change can lead to resistance to innovative teaching. Also funding for teaching developments may have to compete against research projects. However, it may well be possible to use arguments relating to institutional strategy, teaching quality assessment, quality audit and departmental image & marketing to overturn those objections.

Other possible impediments include colleagues with computer phobia, or a reluctance to use computers in teaching for other reasons, and potential problems with workload allocations. Using LT may mean you spend less hours in contact with students, but more time preparing material and no reduction in marking. If this is not reflected in work load models, e.g. those based solely on contact hours, there is a possible disincentive to using LT.

There are however other potential benefits to using LT at a personal and departmental level. For example the opportunity to carry out publishable research on the effects of using LT, increased satisfaction due to improved student results and attitudes and the longer term effects on overall workload and increased perceived teaching quality. In general it is probably true that short term returns are likely to be poor but in the longer term they may be significant. It is, therefore, an advantage to be thick skinned & purposeful.

Other considerations

Academic standards

Ensuring academic standards are maintained may mean that there is a requirement to rewrite course or module documentation to indicate where and how LT materials have been incorporated. Writing the appropriate documentation takes time as do the administrative procedures required to get revised documentation accepted by the relevant committees. Plan ahead to ensure that your course or module can run in its revised mode as and when you require.

Systems security and integrity

It will be necessary to integrate systems security features into computer labs which are accessed by classes of students. Seek advice on security issues from the institution's and/or department's computer support staff, particularly where network systems are employed. Virus infection can cause serious disruption to both data, program and system files and it is essential to keep upgrading the virus checkers to protect against new viruses. If computer based assessment is being undertaken it will be necessary to ensure that students do not have access to the data files containing the test materials. Sensitive data files such as these should only be stored on the network when required and it is advisable to store them in an encrypted format for greater security.

Systems should be set up in such a way that student work is not normally stored on the hard disks of computers. In some instances students will require access to hard disks for the creation of temporary files but an automated disk clearance system will help to maintain the integrity of the file system on the hard disks.

Summary

Careful planning at an early stage of introducing learning technologies into the curriculum will assist in the development of effective implementations which are robust and well managed. Well planned implementations are also more likely to be well received by students, one of the reasons that teaching with LT can bring its own rewards and is worth the effort. Political and funding issues may present significant barriers to LT implementation, however some of these may be less real than they appear and others can be overcome, though it may take time to do so. Solving resource issues in terms of staffing (both academic and technical support staff), technology and course design will assist in the timely integration of appropriate learning technologies and help to ensure that students are presented with LT material which will be of value to them in their studies and with which they feel at ease.

9: Motivating students to use learning technology

Jen Harvey & Nora Mogey

The time, energy, enthusiasm and planning that you have invested in the design of your implementation, and the provision and arrangement of resources could all be wasted if you fail to sell the idea effectively to your students. After all, it is the students who are actually going to be working with the technology. An open access resource centre, however nicely decorated, regardless of the technical wizardry included, will not be exploited by the students unless they are given strong motivation for doing so. Simply telling students that there is an exciting package available covering subject X is not enough to actually get them sitting down in front of it, never mind absorbing any worthwhile information from it.

This chapter gives suggestions of different ways that students **might** be motivated to use the technology that you are providing. If you are able to identify several reasons for the students using the material - all the better. Above all your own enthusiasm and belief in the materials you are using is crucial in convincing the students that technology is a useful, important and relevant component of their course.

Make it Relevant (Content)

- Integrate it with the lectures and other parts of the course. Refer to it in lectures and course documentation.
- Use it to reinforce and expand on concepts developed in other parts of the course.
- Only use parts of the package that are directly relevant to the course content
- Give students references to packages, and "pages" in packages, like other references.
- Use a shell (e.g. Resource Builder) to tie together several resources which all support one topic.
- Tell students why it is relevant to them, don't assume it is obvious.
- Get the students to record their work, so that they have something to take away. (If there is nothing to file, it can't be important, but beware of letting students print courseware content just "to be read later".)
- Use it as a basis for revision.

Make Sure it is Appropriate (Right Level)

- In the use of language, jargon, methodology and general style.
- To students' level of computer literacy.
- Lay on training/introductory sessions.
- To student access to hardware - in class time and for self study.
- To the ability to provide help when difficulties arise.

Make it an Experience

- Select a package that presents information in a unique or novel way, not just an electronic book, where the student turns the pages.
- Plan the integration of the materials.
- Vary your methods of presentation and interaction with the students.
- Include clips/interactivity/simulations.

Make it Supportive

- Make sure that help is available if & when it is needed.
- Tell students how and where help is available.
- Be there yourself to help for areas that you know are difficult.
- Run surgeries.
- Pair/Group students into self help groups.
- Offer post test support sessions.
- Don't assume that all students are computer literate.
- Don't assume that all students enjoy using computers.

- Make sure the students know what the aims are for each session.
- Make sure there is access to printed and other support materials.

Make it assessed

- As part of the package, counting towards continuous assessment.
- As a separate file, monitored electronically.
- As part of summative assessment.
- Have a quiz in a tutorial.
- Assess a group presentation based on the content delivered in the package.
- Include a write up of the lab session as part of continuous assessment.
- Log the students who use/complete the package. Make this a pre-requisite for successful completion of the course.
- Assess students' own critical reviews of the LT materials.

Give the students ownership

- Allow students control of the speed of progress through the materials.
- Allow students control of the sequence of progress through the materials.
- Encourage students to use and enter their own data, where possible.
- Allow students some choice of the topics studied.
- Enable students to copy sections of the content to a clipboard/notepad to build their own notes.
- Follow up with an explanation (or presentation) by one student to another.

Make it shared

- Set a group task, e.g. assign students a problem to work through.
- Group students around 1 computer (but make sure there is enough room for everyone to see).
- Involve group members in the assessment of the rest of their group's work.
- Get groups to feed back to the rest of the class in a tutorial setting.
- Use LT materials within a tutorial and stop at regular intervals to recap.
- Ask the students to submit a group project - possibly electronically.

Make it properly integrated

- Don't expect students to use LT just because it is there - Build the LT into courses.
- Follow up the use of the package by running a tutorial, perhaps using case studies based on the material.
- Use the LT in your lectures and make subsequent references to the material.
- Set specific self study group tasks using LT.
- Use in combination or in parallel with other modes of learning i.e. run a laboratory then ask students to go through a software simulation.
- Use the material to demonstrate situations which might not otherwise be possible, for example which might be dangerous, expensive, slow etc.
- Enable students to rehearse situations or to repeat experiments or situations in their own time.
- Select only the relevant pieces of a package rather than using inappropriate material.
- Use the LT to develop a point or to reinforce an idea covered in class.
- Set tasks that cannot be completed (efficiently) without it.

Follow it up

- Ask students for feedback on the LT
- Use the LT as a basis for a follow-up tutorial.
- Ask other colleagues to give feedback - so recommendations can then be passed to the class.
- Look at exam results and do a comparison between results obtained using different packages and pass on this information to students.
- Use class - course committees to give feedback and/or recommendations on LT.
- Look at computer confidence.
- Make sure to act on the feedback obtained - and tell students about it.

Make it interactive

- Have at least one LT material based activity in every class.
- Make sure students are able to record the outcomes of their activity, perhaps by creating notes or getting a printed copy (but beware the tendency to print material rather than to read it).
- Set students a task, asking for a report back after 10 minutes say.
- Give students questions or a problem to solve as they work through the package.
- Give students a workbook or worksheet to go through.
- Get students to report back on what they have learned.
- Get students to fill in the blanks in a handout with what they have learned and use this as a basis for a class record.
- Encourage students to ask questions about the package.

Make it competitive

- Involve groups in a task to be marked by other groups.
- Ask groups to prepare a poster of their findings which will be assessed.
- Ask students to solve a problem and have a poll in the class to vote on which is the best solution.
- Award prizes for the best project/solution etc., for example offer: freetime; less to hand in; beer vouchers; fun activity etc..
- Ask students from other years to mark students' work.

Set targets

- Clarify the aims and objectives for the exercise, particularly if they are not included in package. Possibly provide a paper based copy.
- Get the class to set the goals for the session e.g. have brain storming session and write up goals on a flip chart.
- Write out a timetable or a schedule for students to follow.
- Get students to keep a record of their work or a diary of when they achieved the targets set.

Make it understandable

- Encourage students to ask questions.
- Answer questions honestly.
- Find out the answers to any questions which you can't answer.
- Differentiate between opinion and factual evidence.
- Set up a list of the students' most Frequently Asked Questions (FAQ).
- Refer students to other FAQ lists or relevant web sites.
- Ask students to compile a list of questions. This could be a group exercise.
- Ask groups of students to ask other groups of students questions.
- Set up a discussion or e-mail group for your students.
- Get students to submit questions to you by e-mail.
- Provide written or electronic support about how to use the packages.
- Send questions to students via e-mail.
- Give questions to students prior to using LT.
- Get students from other years to become involved in demonstrating.

Be an enthusiast

- You must know what you are doing and convey this to the students.
- Make sure you know exactly what is in a package before telling your students to works through it.
- Pick out material which you enjoy working with and feel comfortable with.
- Enjoy working with the students and share their enthusiasm.
- Promote interaction in the class. Stimulate discussion and follow ups.

Enhance students' self confidence

- Make it easy to use.
- Provide positive feedback.
- Provide corrective feedback in a positive way.
- Provide helpful formative/self assessment.
- Don't undermine students' self confidence in the subject or the use of LT.
- Avoid unnecessary barriers between the students and the LT.

Make it fun

- For you

  and

- For the students.

10: The use of computers in the assessment of student learning

Nora Mogey & Helen Watt

Increased numbers of students in Higher Education and the corresponding increase in time spent by staff on assessment has encouraged interest into how technology can assist in this area. Ensuring that the assessment methods adopted reflect both the aims and objectives of the course and any technical developments which have taken place is becoming increasingly important, especially as quality assurance procedures require departments to justify the assessment procedures adopted.

Introduction and definition of terms

Assessment consists of taking samples of behaviour at a given point in time and estimating the worth of those behaviours. Thus the underlying assumption of assessment is that it provides a representative sample of behaviour of the person being assessed. On the basis of the kind of sample taken inferences are made about a persons achievements, potential, aptitudes, intelligence, attitudes and motivations. All forms of assessment provide estimates of the persons current status.

Before performing any assessment it is important to ask ourselves three questions:

- What is this assessment for?
- Who is it for?
- What is the context?

Criterion referenced assessment refers to assessment based on explicit criteria and targets. Does the student have the necessary "mastery" of identified components of the course of instruction? In this type of assessment the requirements of a pass level are defined in advance, as learning objectives.

Norm referenced assessment refers to assessment which is used to establish a rank order of achievements or aptitudes with a group of students, across &/or through time, providing a continuum of performance. Standards could be established partly by controlling the percentage of students awarded each grade.

The three functions of different types of assessment are:

Diagnostic:- to identify strengths and weaknesses.

Formative:- to provide feedback to students.

Summative:- to estimate performance for the purpose of (formal) assessment at the end of a course or unit of study.

In practice the types and functions of tests are not clear cut. For example, mid course/unit formative assessments are often used as an element within multiple summative assessments.

Overview: Using IT in assessment

Technology can be used for assessment purposes at various levels ranging from the management of the assessment information to a fully automated assessment system. Using technology for the management of assessment information can enable information to be presented in different ways to meet the needs of different audiences (such as teachers, students, course organisers and external examiners). Not only the quality of presentation of reports but more importantly the range and scope of their content can be improved by utilising technology for this purpose. At the other extreme, in a fully automated assessment system all aspects of the system from the assessment which the student completes to the processing and administration of the marks, including the overall management of assessment information, is technology-based.

Assessment strategy should be considered during Course Design, here it is useful to ask ourselves:

- What kind of things do we want our students to learn?
- What opportunities will be provided?
- What assessment tasks will be set?
- What methods of assessment will be used?

Analysing the types of learning which we require to take place has significant implications for the instructional design, assessment strategies and methods. Since assessment involves measuring it gives rise to problems in: Choosing a valid assessment instrument; Finding a suitable unit of measurement; Ensuring the test is measuring what it is supposed to measure; Scorer reliability, especially if more than one marker is involved; Using valid statistical methods and drawing valid inferences from measures.

Why change current practice?

- Drive to find effective new and improved assessment methods.
- Focus on Quality Assurance.
- The changing aims of HE (mix of academic, vocational and general transferable skills).
- Emphasising deep learning rather than shallow.
- Interest in using new teaching methods.
- Need for greater cost effectiveness.
- To save staff time.

Advantages in the use of IT for Assessment

- More frequent formative and summative assessment.
- Staff can be alerted sooner to adapt their teaching.
- Can spend less time marking.
- Self-assessment; in the student's own time, at their own pace, when they are ready.
- Increased student confidence.
- Students like rapid results.

Electronic delivery of tests

Objective tests

There is growing interest and increasing practical experience in the use of computers to deliver objective tests. Objective testing is often taken to imply the use of multiple choice questions (MCQs). However, objective tests can incorporate a wide range of question styles in addition to standard multiple choice questions; for example multiple response, word entry, number entry, gapfill and free-format where student entry is compared to a correct solution using a keyword search. Objective tests, and MCQs in particular, are generally considered to be an efficient method of testing factual knowledge, enabling a wide syllabus to be examined in a relatively short time. It is, however, important for academic staff to be aware of the limitations of objective tests (especially MCQs), particularly in their inability to indicate higher level and process skills. Objective tests can be used for both formative and summative assessments, and a variety of scoring systems can be applied, tailored to the importance of discouraging students from guessing answers.

Several packages are available which are designed for the electronic delivery of objective tests (e.g. Question Mark, Examine, EQL Assessor), all of which support the delivery of a variety of question types. Entering questions is generally straightforward, requiring minimal experience with the package. Although the design of questions for computer based delivery is no more difficult than for paper based objective tests, this remains non-trivial and the most time consuming part of the whole objective testing process. Difficulties can sometimes arise where subjects require the use of specialised notation (such as for mathematics, chemistry or linguistics) but these can almost always be overcome by the use of appropriate specialised fonts, or the inclusion of small

graphic objects. When the test has been completed the students responses are marked automatically, quickly and consistently.

Computerised delivery of objective tests offers interesting possibilities not available within paper based systems:

- The creation of a bank of questions invites the possibility of each student being presented with a paper made up of different questions, but of an equivalent standard. (Some words of caution need to be associated with such an approach - the identification of questions which are truly of an equivalent standard is not a trivial task.)
- Instant computerised marking facilitates immediate feedback for the students.
- Students can be invited to sit tests as frequently as they find useful.
- Computerised recording of results facilitates the analysis of groups' responses to questions.

Structured questions

Electronic delivery of tests need not be restricted to MCQs, and the results recorded need not only be whether a response is right or wrong.

Consider the situation where a question has been posed, but the student is unable to get started. In a traditional setting (for a summative test) this student would be forced to omit this question and try another. In an electronic setting it is possible to include an option to provide a hint for the student. Most computer based assessment packages can operate in a choice of modes, perhaps described as tutorial or exam mode. The exact number of modes available varies from package to package, but four modes is not uncommon, each offering a different level of detailed feedback for the student, to assist them in reaching the correct answer, or explaining why their response was not correct.

Questions can be split up into several stages, and marks can be awarded at interim stages before a final answer is determined. Marks can be deducted if hints have been provided. For students who have made a slip, the computer can identify an error and offer the possibility of going back, correcting an interim answer and hence enabling the student to successfully reach the final stages of a question.

Electronic generation of tests

In addition to using electronic packages to create unique tests, it is possible to use the computer to generate different tests automatically.

Question banks : Electronic selection of questions from a bank has already been mentioned as one possibility for the electronic generation of tests. The creation of a question bank is a demanding task for a single individual, however, where several members of staff (possibly from different institutions) collaborate to share questions a large bank can be established relatively quickly. From this a huge number of different tests can be generated.

Randomisation of parameters : An alternative method of generating questions electronically is the use of parameters. The format of the question will be identical on every occasion, but one or more variables in the question is selected from a list of permitted values. These values may be entered when the question is created, or they may be generated by the computer, either randomly or according to some formula.

Feedback from students indicates that the opportunity to work through questions is often considered to be very helpful in identifying areas of weakness in their knowledge, or in developing a confidence in their understanding of a subject. Computerised delivery from a bank of questions or of randomly generated problems, supported by automated marking and feedback to the student is a flexible and efficient method of providing formative assessment, particularly where factual knowledge is an important component of the course.

Electronic recording and analysis of results

Perhaps the most immediately obvious and most easily accessible use of technology to assist the assessment process is in the recording, analysis, general storage and management of results. A wide range of spreadsheets,

statistical packages and database packages are available (e.g. Excel, Lotus 1-2-3, Dataease, SPSS, Minitab, Access), into which it is easy to enter data manually if results are not already in electronic form, though enormous care must be taken to avoid transcription errors when generating the data files. Most of these packages readily accept the transfer of electronically stored data from other applications, aiding data acquisition and increasing the potential data analysis that can be carried out.

Results from several assessments, courses or modules can be collated quickly, easily and accurately for discussion at examination boards, and the volume of paper required for long term storage can be dramatically reduced. Further, any trends within the data can be fully explored, which in turn provides valuable feedback for the academic team.

Final scores vs. other information

It is sometimes useful to record data other than how many right answers the student is able to achieve, particularly when the assessment is formative.

The use of interim stages in a problem to provide feedback and guidance to students has already been mentioned. Some computer based assessment packages record all the interim responses from the students into a file, which is available to the tutor for diagnostic purposes, if required. Other packages require students to log on before using a package, so that frequency of usage of the package can be monitored. Another practice is to record the length of time for which students are logged onto the system. This can be helpful in identifying students who achieve high scores, but only when they have a lot of time to do so, compared with students who may score less highly, but who spend very little time on the test.

As outlined above other information relating to the path a student followed through a package, the frequency of usage and the time taken to complete sections can be stored. Although this can provide teachers with useful information it can often cause concern to students if they have had to enter identifying information before accessing the package. Some students are anxious about the use to which such information will be put. However if students are informed when given operating instructions for the package of the use to which information will be put then this anxiety is usually alleviated and students will feel happier and more motivated to use the software particularly for formative assessment purposes.

Electronic scoring tools

The use of electronic methods to store and manipulate data becomes pointless if the integrity of the data cannot be guaranteed. The manual entry of marks is particularly susceptible to error, time consuming and costly to check thoroughly. The use of data capture devices, such as an Optical Mark Reader (OMR) connected to a computer, can vastly reduce input errors, particularly the problem of number transposition on data entry, e.g. typing 45 instead of 54.

Standard pre-printed OMR forms can be a cost-effective way of collecting student responses to questions. A pencil or pen mark is made on the form by the student to indicate each selected response, i.e. their answer to a particular question. No special training is required for this just some simple instructions re entering responses clearly in the designated check areas. The completed forms can then be scanned by an OMR to detect the presence of a mark (usually by measuring reflected light levels). The pattern of marks and spaces is interpreted by the reader, following instructions provided by the operator, and is stored in a data record and sent to your computer file for storage. Thus large quantities of information can be entered onto your computer without the need to use a keyboard. Hence increasing accuracy and saving time.

One example of the use of these is for students to record their answers on the pre-printed OMR response sheets although the test has been presented in the form of MCQs on paper.

Software packages are available which allow you to design and print customised forms using a personal computer and a laser printer. An additional feature used in some HE institutions is to allocate an individual bar-code to each student which can be attached to their form. This can be read by the OMR thus decreasing the chance of mistaken identity due to students incorrectly entering their personal identification number, e.g. due to transposing characters or checking the wrong boxes when entering their matriculation number.

Once the student answers have been stored for a test, the responses can not only be scored but can be analysed in a number of different ways, e.g. by individual question, groups of questions, all questions. Thus a variety of reports can be produced such as: the results of individual students; the results of groups of students including

the mean, median and modal scores; graphs of results; analysis of each question including its reliability, facility value and discrimination factor.

Security considerations

One obstacle which can prevent teaching staff from utilising technological solutions to administer student assessment is the worry of security. It is hoped that the following practical suggestions will help to put the reader's mind at rest on some of the issues which may concern them.

When considering delivering assessment on computer, it is possible to password protect the file containing the test and also to disallow access until after a particular date. To overcome the possibility of students copying from each other's visual display screens, the possible responses to each test question can be displayed in a different order. Also databanks of questions can be used which means that each student is sitting a comparable but not identical test. There is of course the problem of obtaining access to sufficient equipment to deliver a test to all students in a class at the same time. This does require careful preplanning to book the facilities and to ensure that the test is available on all the machines simultaneously. Usually this means that additional support staff, such as computer suite managers, will be involved in assisting the course teaching staff in organising the delivery of the test.

Ensuring that the person completing an assessment is who s/he says they are (authentication) is an issue in all examinations and is not a security issue specific to computer based assessment. However, in a computer environment impersonation may be perceived as a greater risk. The most obvious way to control this issue is to set summative assessments in exam conditions, checking identities against matriculation cards etc. and checking these against the candidates computer log-on information. Authentication of remotely sat examinations is likely to remain a problem - as it is with paper based assessments.

Sometimes due to class size and the availability of equipment it is not possible to arrange for all the students to sit the test simultaneously. One solution to this problem which has been successfully used is to divide the class into two sections. The second section sits the test immediately after the first. In order to eliminate any possible transfer of answers from students in section one to section two, the first group leaves the computer cluster by a different route than that taken by the second group to enter, e.g. via the fire-escape door rather than the main entrance. However students themselves are self-motivated not to transfer any information to their peers as it may disadvantage their own showing in a test.

Plagiarism should present no greater problem in an electronic environment than in a more traditional context. However, the "cut and paste" facility of word processors and information retrieval systems may tempt students to copy sections of text directly into their work. This is a potential that has to be guarded against in the same way as text manually copied from other sources - largely though the style and quality of English used. Peer group assessment where each member of the group awards a share of the total marks to their group collaborators may present another practical guard against plagiarism and could appropriately be employed in some situations. Students should also be made aware of the law relating to copyright, especially when they are asked to compile portfolios or other multimedia presentations.

Storing student marks on a computer file is not necessarily more prone to student access than traditional means. It is possible to password protect a file to stop unauthorised access. If the machine on which the file is stored is not networked then any potential infiltrator would require to obtain access to the room in which the computer is situated as well as cracking the password. If the file is stored on a floppy disk rather than on the computer's hard disk then this can be locked in a filing cabinet in the same way as paper-based marks but will in fact be more secure than the paper-based version as in order to view the data the person seeking access to it would require to know the name of the file, have access to appropriate hardware and software and be able to enter the correct password.

Electronic support as a tool in the assessment process

There are many other ways in which computers can assist in the assessment process. A few of these are outlined below. Of course, not every example will be applicable in every subject area or every course.

Technology as an administrative and management tool

There are a number of examples of Integrated Learning Systems (ILS), where entire course structures, lecture, practical and assignment schedules and supplementary resources are held electronically and available for student consultation whenever needed. The management of assessment schedules is just one small part of an ILS, and an equivalent benefit is available through the use of other, less holistic tools.

For departments where electronic mail is available this offers both tutors and students an efficient and straightforward means of communication. One application is to use e-mail to remind students of impending deadlines. Even students who are absent when the message is first posted are certain to receive the message when they next access their mail. Similarly any changes, revisions to the assignment, or hints can be delivered to all students.

Assignments can be submitted electronically. For distant learners this avoids the need to rely on the speed of postal services, and for all students the date and time of delivery is automatically attached, so meeting deadlines can be monitored accurately.

Computers are an ideal tool to track attendance or achievement records, allowing monitoring of trends, for individuals and cohorts, comparison between years or classes and early identification of problems.

Word processing and direct presentation tools

Encouraging or insisting that students word process assignments is now widespread. A similar strategy is to promote the use of IT tools (e.g. Powerpoint, Freehand) to support oral presentations. In both cases students can be encouraged and assisted in the development of a professional attitude, in addition to academic considerations.

Word processors are invaluable to those with poor spelling or who would produce an illegible script. If these skills are important, then perhaps use of technology should be actively discouraged. Insistence on all assignments being word processed may effectively penalise students who possess fewer keyboard skills, or those who have more difficulty in gaining access to the necessary equipment. (Access issues are discussed more fully in chapter 8). The correct balance must be sought between the time invested in the appearance of an assignment and the time invested in consideration of its content; students, particularly early in their courses, may require clarification and assistance with these issues.

There are a number of collaborative writing tools now available, at least one of which, Common Space, has been written and designed specifically for educational use. Common Space could be used by a group of individuals involved in a collaborative creative process, where each can comment on and revise the ideas of others in the group, or by tutors to give feedback on early drafts of a document. Comments can be as text or as audio recordings. It offers a number of features to promote flexibility and adaptability in integrating comments and revisions from a range of different sources. Similar annotation, comment and revision marking features are provided in most quality word processing packages.

Electronic seminars

Electronic mail has already been mentioned as a useful administrative tool. It can also play a supporting role in the whole process. Examples exist of courses where seminars are presented electronically, rather than in a tutorial room as is conventional. The student leading the seminar prepares a paper and submits this by e-mail to the group for consideration. Some electronic discussion follows, prompted where necessary by the tutor. After a few weeks the student 'presenting' summarises the discussion, and presents a revised paper.

Such a structure is extremely flexible in making demands on the student's time. The contribution of all students to the discussion is marked by the tutor, hence all students are encouraged to contribute, however those who might naturally be more reserved have the opportunity to consider their contributions rather than being forced to make them as soon as an idea or question occurs to them.

Management of such seminars does require skill from the tutor in judging just when to contribute a comment in order to keep discussion going. It also offers possibilities for peer group assessment and other less traditional methods.

Portfolios and other simple authoring tasks

Technology can be important in the assessment of transferable skills, and can be used to promote collaborative assessments, shared between more than one subject area. Although it is not advocated that students should as a rule be encouraged to be authoring or creating packages, this can be a useful means of promoting a deeper understanding of many of the issues relating to the use of and evaluation of technology.

A similar idea is the development of computer based portfolios where students can create multimedia packages with simple links between different resources. These could be used for the creation of portfolios where students have gathered a range of resources, such as graphics, audio and video clips in addition to text and links to relevant pages from the world wide web. Students could also be assessed on their ability to create a relevant and linked portfolio of World Wide Web resources, which can quite simply be created by writing Web pages in HTML (hyper text mark-up language), possibly using the conversion and editing tools provided for several standard word processing packages. The structure of the package/portfolio and relationships between the links included in the materials can be a reliable indicator of the depth of learning. Electronic portfolios would be plausible for a wide range of academic subject areas, and could also be used for group or peer assessments.

Many students will be expected to use technology in future careers, and perhaps to compare and contrast the features offered by different packages. Asking students to create a simple package or portfolios of linked resources, to evaluate each other's products and produce a critical report on their own can foster a range of transferable skills, and promote a deeper level of learning. Packages can be targeted at a vocational use, or could illustrate and explore a single academic concept. In some situations the products created by one cohort may be suitable for use by following years.

Simulations

Simulations have been in use for many years to assess likely performance in hostile environments, particularly, but not exclusively, as a formative assessment tool. A simulated environment can never be quite like “the real thing”, as assumptions, simplifications and restrictions will have been programmed into any simulation - creating problems of realism. However, assessment problems associated with experiments in the real world, which sometimes behaving unpredictably, can be avoided in a simulated environment.

Simulations can be used to investigate problem solving skills, perhaps allowing the student to explore a range of options. They provide a range of flexible assessment tools, suitable for individual or group exercises, under open or closed conditions. In addition to assessment of the academic content of the simulated environment, they can be used as a tool in the assessment of group interaction processes.

Diagnostic assessment

A range of diagnostic tools exist, both for student and tutor use and information. Two specific examples are introduced here to give some indication of the variety of tools available.

DIAGNOSYS is a knowledge based package to investigate mathematics skills on entry to university. The questions have been designed with great care, it is not intended that users of the package should alter them. The tutor can identify which topic areas are relevant for investigation, and the student then sits a test, delivered and assessed by the computer. The test is adaptive, that is, not every student gets the same set of questions. As students answer correctly or incorrectly the computer selects a new question from its bank in order to check more fully on the particular skills of that student. Hence students are not faced with a whole series of questions that they cannot attempt to answer, or a whole series that trivial are to them. The diagnostic report can be made available for either the student or the tutor. Individual or class profiles can be provided.

THESYS is a package designed as a formative self assessment tool for students preparing a project report. Thesys presents the student with a series of questions examining the structure and content of their report, and then provides detailed advice and suggestions on where additional information would be required in order to achieve a higher grade. An estimate of the grade that this project would achieve can also be provided.

Summary

The overall balance of assessments in a course is of vital importance, and although computerised testing facilities can provide a rapid means of assessing and providing feedback to large numbers of students it is

essential to consider their use as part of the overall course/unit strategy, especially as multiple choice/limited response type questions can lead to an emphasis on "shallow" learning.

Electronic assessment tools are unlikely to reduce significantly the burden of assessment, but they can be used to promote deeper and more effective learning, by testing a range of skills, knowledge and understanding. Using computers in assessment does not have to mean more multiple choice testing to the exclusion of other assessment techniques. A wide range of innovative assessment methods lend themselves to computer based implementation.

Further reading

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11: Observing, measuring, or evaluating courseware: A conceptual introduction

Stephen Draper

Introduction

Numerous people are involved in some way in introducing learning technology into teaching, whether in acquiring and using some software developed elsewhere or in authoring new software. Having put in considerable effort during a project, we generally wish (or are required by others) to be able to show something about the results. Simply delivering the software on a disk is seldom felt to be enough: what can we do to pull together and present further evidence?

I shall refer to all such further evidence as "evaluation", and to the teaching material being evaluated as "courseware". In principle the same issues apply to all teaching methods from lectures and textbooks to computer software, multimedia, and advanced telecommunications. My views have grown from work in higher education, but may well apply in other areas of education. In what follows I offer an introduction to the basic issues of evaluating courseware in higher education, and an overview of some useful distinctions.

The simplest evidence is to list the functions of the software, or to list the number of people who bought or used the software. Such evidence is weak however because purchase, acquisition, and use depend as much on opportunity, available money, and advertising as on the quality of the courseware. Better evidence comes from inquiring about the effects, and there is a great range of methods to choose from: from asking informally how the teacher felt it went, to running a big controlled experiment.

What is the question?

As many writings and "methods" of evaluation say, the apparently obvious place to begin is with identifying the goal or purpose of evaluation: if you don't have a question you don't know what to do (to observe or measure), if you do then that tells you how to design the study. Many studies begin with questions like "Do the students learn more with the new software?". But you must ask yourself whether you are sure the question given is the right question. After all, many questions are not. You could ask what colour a lecture was, bring in a spectroscope and take measurements during a lecture, but none of that would make the question sensible or get over the false presupposition that lectures have a colour. Similarly many people have talked as if "are computers good for learning?" was a sensible question, even though they would probably not have asked "are books good for learning?". Only if you are sure you know what the question is, that it is sensible, and that no surprises are possible, is it safe to base a study simply on making measurements that answer the given question. That is why including open-ended observations and questions is so important as part of most studies.

On the other hand, it is seldom helpful to approach a study with a blank mind. One place people go to for help is experts. Among other things, expertise gives a person experience of what the important issues and questions are likely to be. Every past problem can be turned into a question to check in the future, although of course there is no guarantee that new problems will not emerge in new projects. Machell & Saunders (1991) in fact is basically a large, structured collection of questions, and novices to the field of evaluation find this very useful as a way of getting started. However it is important to recognise the present (and probably permanent) state of the field of education: no-one has a precise predictive theory of teaching or learning. Experts' experience allow their estimates to be of more value than novices, but it is not very accurate all the same. This has two consequences: that you must continue to ask whether your question is the right one and to make open-ended observations that may alert you to unforeseen issues, and that estimates, no matter how expert, are not going to be as accurate as actual measurements i.e. observing real students learning will always be more informative than consulting teachers and other experts, although it is usually more difficult and expensive. (Note that education is not so different from a lot of engineering in this respect: that is why testing is so important a part of most engineering projects, despite the expense.)

Planning and resource constraints

As with very many activities, no amount of expenditure guarantees getting what you really want, yet better quality results do require more resources. The maximum quality of the evaluation in many projects, and hence the quality of the lessons they can leave behind, and hence the long term usefulness of the projects as a whole, is effectively limited when they are set up. If time, money, and the skills for evaluation brought by hiring appropriate people, are not planned for and funded, then the outcomes are limited.

Yet planning is perhaps a more important limitation: provided evaluation is planned for from the start and kept high on the agenda, then useful results with modest resources are attainable. But without planning and management that keeps evaluation a high priority, it will not happen: evaluation cannot be effectively tacked on as an afterthought like writing an extra project report. This is most evident with projects centred on creating new materials. If testing and evaluation are not planned for as essential, then as the end of the project looms it is a rush to get any version at all finished, and the software will never be tested on learners. The chances of it being satisfactory are about the same as those of a pedestrian walking across a motorway without injury, because we just cannot predict accurately whether and when students will learn. In fact such miracles have occurred, but few would conclude that that shows the procedure to be reasonable. Learners behave like motorists in such cases, and will avoid a disaster caused by others if they can: they will probably be very angry at having to work round the design faults, but since they want to learn they will do so even if it means going to the library afterwards to compensate for the deficiencies of the courseware.

Allowing for testing is crucial, and even if relatively little time and money is spent on it, planning for it is crucial so that a working version of the software is ready in time: and that time is often determined by the availability of suitable test subjects. Furthermore, in development projects, more time after the test must be allowed for in which modifications suggested by the tests can be made. These are often not very lengthy to make, but they must be allowed for at the planning stage. Useful evaluation leads to action, therefore evaluation is largely wasted if it is done too late to make changes.

Planning at the project level, then, is the most important requirement. This is not only true in development projects, but also in projects centred on introducing courseware that is already finished. Here, evaluation will revolve around classroom trials, and these in turn are constrained by the availability of classes for the trials: often once a year at a time determined by the institution and not the project.

The main issues

Given at least some resources, and that planning was done in time, what might an evaluation consist of? The choices are enormous, and many of them are laid out in the references cited below. However there are perhaps two dimensions that turn out to be most important in understanding the space of choices.

Opinion, memory, and observation

The most convenient method for an evaluator is to ask someone else, preferably an expert, for a judgement. This is what journalists do almost entirely. It is obviously better than just recording their own opinions. However the opinions of (possibly interested) onlookers is not as informative as that of the learners themselves: that is why it is becoming standard practice to use student feedback questionnaires in teaching, rather than the teacher's own opinion of their performance, even though teachers are often aware of their own major strengths and weaknesses. However asking someone (a learner) retrospectively about a teaching episode, which is what all questionnaires do, is not nearly as informative as gathering on the spot information as it happens; although the difference in quality depends strongly on what is being asked about. For instance, when we ask students to tell us how long they spent on each learning resource (how long on an exercise, how long looking at the textbook) they have a lot of difficulty and are almost certainly very inaccurate. Similarly if you ask students to write down the worst feature of a piece of courseware, they can do this, but if you ask them to tell you about every problem they will forget most unless you ask them as they go along, when you will get perhaps five times as much information (at a cost of course, particularly to the student). This is because memory is much inferior to on the spot observation and recording. Questionnaires and interviews rely on memory and are therefore less valuable than on the spot observation, and the longer after the event they are, the less valuable they are.

Similarly an "experts' " opinion is less valuable than that of a teacher who has tried the materials on students, and a teacher's opinion is less valuable than those of actual learners. Learner's opinions however are often less trustworthy than behavioural tests (e.g. assessment scores): for instance men generally feel and express more

confidence about what they have learned than women, while scoring no better on tests of what they actually learned. Again, cost and convenience run largely in the opposite direction (it is easier to ask opinions than to set and mark tests), and in practice a compromise must be decided.

In summary, although costs and opportunities may not often allow optimal methods, it is in general best to base evaluation on actual learning by representative students who really want to learn (not the opinions of onlookers or the performance of special subjects brought in for a trial); to test what they actually did learn, rather than asking whether they felt they learned; and if possible to observe them as they try to learn, and pick up as many observations from them as possible. Of course this is itself disruptive, and must often be avoided. The trade-off here will be between getting the most useful information pointing to what changes to make to a design, and getting the most representative overall results. A development project might do well to decide to run some tests in a relatively disruptive mode as early as possible, and having refined the design run less disruptive tests to obtain evidence of final performance. Personal observation and interviewing gives better information than questionnaires, but on the other hand realistic classroom trials usually have all students learning at the same time, so questionnaires may be a sensible compromise in order to get data from the whole class with only one or two investigators.

Systematic surveys vs. surprise detection

The other major issue is that of the need for both answering systematically questions we are interested in in advance e.g. did all students learn the material up to some criterion, and detecting unexpected problems and issues. An analogy with visual perception may be useful. One thing that perception does is support specific tasks such as checking whether a particular friend's car drives past you: you scan all cars, make sure you don't miss any, and without bothering about irrelevant attributes of the cars e.g. how dirty they are, whether hub caps are missing, look at the identifying features (perhaps the registration number, or the colour and size). Another thing perception does however is allow you to notice completely unexpected things, such as a tiger walking down the street towards you, someone's umbrella which is just about to poke your eye out, or a street vendor offering venison which would do nicely for your dinner. It will do these things even though you did not plan to do them, and could not say that, for instance, you noticed everything on sale by street vendors.

Similarly with evaluation: it is important to cover both functions. Methods such as exam-type tests and questionnaires with fixed response categories will never warn you that something you did not anticipate is in fact important in the situation you are studying. Hence it is vital always to have some open-ended questions and preferably personal observation by the evaluator. In fact if at all possible it is best to run two studies, so that issues thrown up by the open-ended measures in the first can be used to do systematic surveys in the second. In this way, you can discover whether the 2 students who mentioned that the screens were hard to read in bright light were unusual, or in fact represented an issue that worried all the students. As this example shows, however, open-ended questions and observations are not a substitute for fixed questions: only by putting the same question or task to each learner and requiring the answers to be expressed using the same categories (or marked using the same coding or marking scheme) can you get comparative results that allow you to discover and report results such as what proportion of learners were affected by an issue.

Any evaluation study, then, should have both open-ended measures for detecting surprises, and fixed measures for generating comparative data that can answer specific questions. Without fixed measures you may not be able to say anything definite about the courseware: only an unstructured set of observations and opinions from individuals, which may or may not be shared by the other learners. Without open-ended measures you have no chance of detecting problems or anything you did not think of in advance, and it is from the unexpected that most important improvements stem.

Four types of evaluation classified by aim

When we consider possible approaches to educational evaluation, there are four general types described in the literature. We describe them in turn. They are not wholly mutually exclusive, but distinguishing them may be helpful before they are combined in individual cases.

Evaluation of LT materials/CAL (computer assisted learning) is in fact intimately linked with the authoring and dissemination process. Thus approaches to evaluation reflect either what the authoring process seems to be before evaluation is considered, or else what the evaluators think it ought to be in order to make evaluation useful. Another way of putting this is that evaluation can be designed for different purposes or roles:

- Formative evaluation: to help improve the design of the CAL.
- Summative evaluation: to help users choose which piece of CAL to use and for what.
- Illuminative evaluation: to uncover the important factors latent in a particular situation of use.
- Integrative evaluation: to help users make the most of a given piece of CAL.

As far as I know the terms, though perhaps not the ideas, were introduced as follows: "formative" and "summative" by Scriven (1967) (see also Carroll & Rosson (1995) for their subsequent use in Human Computer Interaction); "illuminative" by Parlett & Hamilton (1972/77/87); "integrative" by Draper et al. (1996).

The consumer view: summative evaluation

The default "common-sense" view that tends to occur spontaneously to many people is that evaluation of CAL is rather like consumer reports on goods: the manufacturer designs and supplies them, then someone else does tests and produces reports to help purchasers decide which to buy. This view of evaluation is linked to a view that CAL is produced like textbooks and other goods, and that evaluation is not expected to have any direct effect on the CAL itself by telling the authors how to improve it. Nor is it expected to help consumers in how to use the product: only which to buy. Thus this is a common view for perhaps these reasons: it fits the fact that a lot of CAL is produced like a lot of textbooks by a very small team of authors with no spare resources for testing; it fits with a tradition in the literature for comparative experimental testing (which can compare two sets of teaching materials well); it fits the needs of new CAL users to decide what to buy; and more broadly it is analogous to consumer reports and how we encounter most of the things we buy, which we are offered without being consulted about how we would like them designed. This form of evaluation is covered in greater depth in chapter 7.

Formative evaluation

One important use of evaluation is while it is being developed: testing it on learners while there are still resources for modifying it. This is the simplest way for evaluation to help authors (developers); to try out the CAL material on users, preferably as similar as possible to the students it is intended for, and use open-ended methods to report the problems that arise and perhaps also to suggest amendments. Although often the time necessary for this is not allowed for in development plans, once a developer has experience of it, it is usually clear how useful this is. After all, testing is part of all engineering, and feedback from students is also used by almost all lecturers to adjust their lectures and handouts. The key point to realise when using it for CAL, is that such testing must be done in time to allow changes to the material in the light of the results before the end of the development period. This kind of testing is called formative evaluation, as it is used to modify ("form") the material.

The most realistic, and so most helpful, formative evaluation would use real students in their normal learning situation. This is likely to increase the time for the whole cycle of production, testing, and modification. Feedback to developers from sites who are early users of the material is a helpful substitute that gets round this constraint. Although this practice really means that users are running poorly tested software, and in effect doing the testing that producers should have done themselves, it is better than having no way of catching problems and improving the software. It, in fact, corresponds to common processes in commercial software production, where producers keep track of users and collect performance reports in order to improve later releases of their software.

More information on planning this kind of evaluation can be found in Alessi & Trollip (1991), and in McAteer & Shaw (1994). As noted above the key constraint is planning to do the testing early enough that changes can be made. The reward is a significant improvement in quality of the end product. Thus the main added result will not be a report, but the modifications to the design actually done.

Illuminative evaluation

"Illuminative evaluation" refers to what might now be called loosely, and perhaps incorrectly, ethnography. The basic idea is for the investigator to hang out with the participants (students, teachers, etc.) to pick up how they think and feel about the situation, and what the important underlying issues are. For a more precise view and examples see Parlett & Hamilton (1972/77/87) and Parlett & Dearden (1977). Its importance is as an open-ended method that can detect what the important issues are, without which other methods often ask the wrong

questions and measure the wrong things. For instance most studies still fail to measure motivation in any way, yet much CAL would never be used if it were not made compulsory by teachers or experimenters. However this is not a universal truth: in some cases students have a strong desire to use the CAL independent of coercion, in others they are indifferent and use it only under compulsion but without disliking it, in yet others they continue to express strong revulsion (even though educational tests show educational benefits).

Another even simpler example concerns lectures: providing handouts and using slides were intended to augment the voice medium and make things easier for students, but it turned out from informants that this created a new problem for students of discovering from moment to moment what the connection between the three channels was (e.g. was the current slide on the handout or did they need to write it down?). Simply measuring the effectiveness of using the extra channels might have shown a reduced rather than an increased benefit, but without giving any clue about what the problem was. Illuminative evaluation is in effect a systematic focus on discovering the unexpected, using approaches inspired by anthropology rather than psychology.

TILT's "integrative" evaluation

The TILT project at Glasgow University has done many classroom studies of CAL. The kind of study they have concentrated on is of the real use of CAL as part of university courses, but with evaluators who can gather more and fuller information than a teacher alone can do through student verbal questions and standard course feedback questionnaires. They have begun to argue that these evaluations serve a rather different purpose than was first envisaged. They argue that for many teachers in practice, the question is no longer whether to use CAL or which package to use: this has often been decided already. Instead, for them the question is how to make the best use of CAL material they are already committed to using. Classroom evaluations typically give lots of information that can be used for this. For instance if all students complain about some issue, or score badly on a quiz item corresponding to an issue, then teachers immediately respond to the evaluation report by adjusting in some way e.g. making an extra announcement, or producing a supplementary handout. Thus a major use of classroom evaluations in practice is to be formative, not of the CAL itself, but of the overall teaching and learning situation. This of course can be and is responsive to local variations in how the CAL is used, and for whom. It can be a significant help in integrating CAL material into varying local situations and courses: Draper et al. (1996).

Approaches to method

The methods you use and questions you ask will depend partly on what you hope to use the evaluation results for (see previous section) and partly on your views about methods.

Checklist approach

Machell & Saunders (1991) offers a structured approach to identifying the questions you are interested in from within a large space of possible concerns, pulling them together, and so perhaps generating a questionnaire for learners or a checklist for course organisers. This would lead to a report on courseware based on the pre-existing concerns of the evaluator, and largely relying on (memory for) experience of the courseware and its use.

What the participants feel

An alternative approach is not to rely on what the evaluator thinks, but to ask learners what they feel. A rather trivial form of this is common, in which a simple questionnaire asks learners whether they liked using the courseware — the "how was it for you?" approach. The problem with this is that it asks for opinions about enjoyment instead of measuring actual learning, and such feelings are strongly influenced by many things other than learning such as novelty or a desire to be polite to a concerned teacher. At the other extreme is a careful "illuminative" approach that identifies all the stakeholders (those affected by the courseware) and uses participant observation and in depth interviews rather than a short questionnaire. Parlett & Dearden (1977) and Murphy & Torrance (1987) illustrate work of this kind. In designing evaluations it may be best to avoid both ignoring and relying wholly on measurements of feeling: open ended observation of some kind, as argued above, is a crucial component of any evaluation; and learners' enjoyment and feelings are outcomes that it is as well to measure among others.

Addressing the whole situation

Courseware is generally only of interest if it promotes learning. However to the extent that it does, it only does so in conjunction with the wider teaching context in which it is used: how it is supported by handouts, books, compulsory assessment, whether the teacher seems enthusiastic about it, support among learners as a peer group, and many other factors. Major implications for evaluation follow from this. It is not possible to evaluate courseware by itself: you can only evaluate its effect together with that of the surrounding support it had in the situation studied. Evaluation must cover not just the courseware but the way and the situation in which it is delivered; and the results may only apply to that specific case.

Draper et al. (1994) is a rather pessimistic development of this point, concerned more with problems than solutions, but it does focus on the issues involved in looking at what actually determines learning in practice rather than only those issues most directly controlled by developers and distributors. In this it is in line with the emphasis above on the need for open-ended measures as well as systematic ones in order to detect issues that were not anticipated by the evaluator but which are important for how the courseware fares in practice.

However a focus on the specificity of the case can be a virtue: it allows evaluation to support teachers in getting the best out of a piece of courseware by optimising its integration into the particular local delivery situation. Although logically such reports do not tell you how the courseware would perform in other situations, building up a set of such detailed case studies complete with how successful they were and what teachers did to make them successful locally is obviously helpful information for other prospective users. Furthermore it accumulates information for teachers on how to use the courseware, which is still too seldom provided by the developers.

The experimental approach

The fourth, and grandest, kind of method is the experimental one. Here some educational intervention (such as a piece of courseware) will typically be tested by a direct comparison of its performance against that of some reasonable alternative (such as the traditional teaching it replaces). Educational journals have many examples of this approach to evaluation for research purposes.

This approach has two important characteristics. Firstly it is usually very expensive in time and researcher effort. A simple experiment comparing the performance of some new educational intervention against an alternative often consumes one or two person-years of research, without counting the input of teachers and other research colleagues. This may be worth it to establish a new idea or theory, but not just to test one of the growing flood of new pieces of courseware. Secondly, any such experiment taken in isolation is open to all the criticisms sketched above that the learning outcomes in fact depend on many other factors besides the intervention being tested, many of which cannot be effectively controlled e.g. the enthusiasm the teachers and students feel about the methods being compared. Furthermore we are too ignorant of what these factors are to have any confidence that they are controlled in any experiment. Such experiments can be taken as establishing that it is now reasonable to take the new intervention seriously having performed well in one real test, but can seldom be taken as proof that it is inherently better or even necessarily effective by itself.

More comprehensive approaches

Above four roles for evaluation were introduced. However, in practice more than one kind of evaluation can and should be done. Firstly, work done for one purpose may turn out useful for another (Draper et al.; 1996). Secondly, different types are appropriate at different stages in the development of an educational intervention (Scriven; 1967, Carroll & Rosson; 1995). In general, evaluation of one kind or another is useful before, during, and after development; and in well designed projects different kinds of evaluation should be done at different stages. One scheme for this has been developed by Diana Laurillard.

Laurillard's evaluation programme

Recently Diana Laurillard has presented a much more elaborate scheme for evaluation in various talks. In this approach, production stretches over years, and different evaluation techniques are used at different stages. For instance, before design begins a "phenomenographic" study (Marton; 1981) would be done of the main problems students experience in learning the topic from existing materials. This can identify both the starting point of students, and the main problems they are likely to encounter: essentially a pre-design analysis of needs. Evaluation in this approach continues through to full classroom trials of the CAL material used in the way specified by the developers.

In a talk in Nov. 1994, Laurillard outlined the following evaluation programme:

1. Pre-program design: Curriculum needs, Learning needs (phenomenographic study), Student access
2. Prototyping: Observation, Comparative trials
3. Formative evaluation: Observation, Pre/post tests, interviews, monitoring, questionnaires
4. Piloting: Observation, interviews, questionnaires
5. Summative evaluation: Questionnaires, interviews, tests, documentation

This method seems a good match for how the Open University teach courses, and also the larger packages produced by TLTP subject consortia for large classes of students in the first year. It seems unlikely to suit the development of CAL for final year options, where a long experience of teaching the topic does not exist, and the final number of students even nationally is unlikely to justify a big development effort. It also seems to ignore the widespread requirement to adapt CAL materials to local needs, where each application will be different and require separate evaluations that cannot be simply compared. This is because any classroom evaluation is really measuring the effect of the CAL material combined with all other components of the local situation e.g. announcements, integration with the rest of the course, etc. As conditions and indeed aims vary across institutions, so results will vary. Hence I would argue firstly for extending the above programme by a sixth step:

6. Integrative evaluation: tests, confidence logs, resource questionnaires (Brown et al.; 1996).

I would also suggest that the relative emphasis and effort put into different stages will depend on the project and the size of the intended student population.

Postscript

As a final note, let me repeat that all of the above types of evaluation could be done, each contributing something different.

Acknowledgements

These views originate in earlier work on evaluation in Human Computer Interaction done jointly with many colleagues including Keith Oatley and Paddy O'Donnell. Their application and adaptation to educational settings was done during my involvement in the TILT project (directed by Gordon Doughty), which is an institutional project funded under the TLTP programme. Consequently these ideas have been enormously influenced by the other members of the TILT evaluation group, principally Margaret Brown, Fiona Henderson, and Erica McAteer. But in writing these notes, I have found myself constantly thinking of remarks by Philip Crompton, who is the organiser of the ELTHE self-help group for evaluation, and represents to me the foot soldiers in evaluation. Those interested is pursuing the debate in this field can contact ELTHE via Philip Crompton (see Appendix 3: Contributors)

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Evaluation is also addressed in the following chapters: Chapter 12 - A practical guide to methods; Chapter 3 - the role of evaluation in the overall process of implementation, and Chapter 7 - a practical guide on how to evaluate LT materials that you may be considering using in your teaching.

12: Evaluation: A practical guide to methods

Philip Crompton

This article seeks to cover the principles for conducting an evaluation whether it is a small or a large project. An understanding of the theory and background to evaluation is beneficial in order to better plan, design and conduct an evaluation programme. Above all there is no substitute for having a clear purpose for an evaluation, defining the right question is a prerequisite.

Definition

> *"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 "Handbook of Education Technology" (Ellington, Percival and Race, 1988)

As the authors point out, Rowntree (1992) makes comment on this definition as follows:-

1. Evaluation ≠ Assessment
2. We should not ignore the unexpected.
3. Evaluation is a planned systematic and open endeavour.

Evaluation and assessment although often used interchangeably, refer to different levels of investigation. Evaluation is concerned at the macro or holistic level of the learning event, taking into account the context of learning and all the factors that go with it, whereas assessment can be seen as the measurement of student learning and is one of the elements that go into an evaluation, the micro-level. One aspect of any sound evaluation is the allowance for the unexpected. Above all an evaluation is a designed and purposeful enquiry which is open to comment.

Approaches

There are initially two distinct approaches to evaluation

(i) the agricultural/botanical or scientific approach or

(ii) the social/anthropological or illuminative approach.

The scientific approach is concerned with the measurement of the effects of specific variables against the resultant outcomes. It seeks to examine the achievement of stated goals in relation to a learner's pre-knowledge and skills. The approach is geared towards the measurement of the efficiency of the educational intervention as well as the effectiveness of the learning outcomes.

The illuminative approach on the other hand seeks to examine and explore the process of the educational intervention. The techniques, as such, are therefore more qualitative, some might say, more subjective in nature as they call on personal judgements.

Though these approaches appear to be at either end of a continuum, it is possible to make use of both within the complexity of what is educational research. A selected mid-point will be governed by that which is being evaluated as well as the reason behind the evaluation. It is not uncommon to see a mix of techniques from both approaches combined in an evaluation project. The degree of combination will depend largely on a process of negotiation between the evaluator and the instigator of the evaluation as well as the environment and the time frame in which the evaluation is being performed.

Whichever approach or combination of approaches is used, the evaluation should always be a clear well thought out undertaking. The more effort that goes into the pre-planning of a piece of evaluation the better the evaluation. Before conducting any evaluation it is important to not only have defined that which you are trying to investigate but also how you are going to go about it.

Levels of evaluation

Romiszowski (1988) differentiates between the scope (Levels of Evaluation) and depth (Levels of Analysis) of an evaluation.

LEVEL I	-	Project Level
LEVEL II	-	Curriculum Level
LEVEL III	-	Unit Level
LEVEL IV	-	Learning Step Level

It is necessary to predetermine at which level the evaluation is to be conducted. Evaluation is of great importance in all aspects and stages of teaching and learning. All too often it is seen as the last activity and yet as Laurillard (1993) states it is an iterative process and should take place at every stage in the design, production, implementation/integration of a new educational intervention (e.g. using LT materials) whether it be as a complete course, part of a course, or a particular session or teaching aid.

There are two possible stages for evaluation;

a) the evaluation of the IT intervention in isolation, and

b) the evaluation of the IT intervention within the course itself.

The evaluation of a piece of courseware in isolation will tend to focus inwardly on various aspects of the software itself. It will look at aspects like navigation, screen design, text layout, etc. It will examine the scope of the coverage of the material content, e.g. is the subject presented to such a breadth and depth that its use is not limited to beginners?

The evaluation of the courseware within the course itself will allow us to examine other factors which will lend themselves to the successful integration of the product within the course. These will be:

- educational setting
- aims and objectives of the course
- teaching approach
- learning strategies
- assessment methods
- implementation strategy

The iterative nature of evaluation should then assist in making the learning experience both more efficient as well as more effective as the feedback is used to continuously improve matters.

It is important to recognise at the outset that evaluation is a time consuming exercise and better planning can save time and effort in the actual evaluation process. It is more advisable to do a small evaluation well than to try to do a large evaluation and run out of time. Remember that an adequate amount of time needs to be allocated to both the analysis and writing up stages.

Effectiveness, efficiency and relevance

Two main concerns for evaluation in the context of the TLTP initiative have been the need to justify technology-based learning on the grounds of effectiveness and efficiency. A third factor should be added to the list and that is relevance; the applicability and appropriateness to the intended employers and users of the technology, the teachers and students, even the department or institution. Whereas Romiszowski (1988) includes this under factors of effectiveness, there is a case for treating it separately. Project Varsetile (Allen, Booth, Crompton & Timms, 1996) encountered technology that would score highly on both grounds of effectiveness and efficiency and yet at the same time be wholly inapplicable for the given context of instruction and learning. Successfully integrating or embedding the CBL package within a course is dependant on relevance.

The following are factors open to consideration and investigation by an evaluation study.

Factors in achieving Process (EFFICIENCY)

- Cost
- Structure
- Alternatives
- Resources
- Organisational

Factors in achieving Objectives (EFFECTIVENESS)

- Cognitive and/or Physical Skills
- Affective

Factors in achieving Satisfaction (RELEVANCE)

- Affective
- Scope of the Content
- Degree of Effectiveness And Efficiency

The evaluation of these factors will lend themselves to improvements in both the course, in terms of aims, objectives and content, and the procedures for the design and development of the course itself.

Techniques

This section will look at the various instruments available to the evaluator and while the list is not exhaustive it is representative of the main techniques used in any evaluation.

Questionnaires

This is probably one of the easiest and simplest instruments to create for data collection. However this apparent simplicity belies the fact that creating and organising your questions can be quite arduous and time consuming. You should be clear about the areas and concerns that the questionnaire is to cover. Do not attempt to ask everything as this will tend to make the questionnaire too long and by so doing decrease the willingness of the respondent to answer fully and thoughtfully.

Designing a Questionnaire

In designing the layout of the questionnaire, leave enough space for responses to open-ended questions but at the same time keep such questions to a minimum if possible. These areas are often better left to semi-structured interviews where a fuller answer can be sought. If these are necessary, keep them to short-answer questions allowing the respondent some space to elaborate on their response.

- Using the standard Likert five point scale makes it easier to collate the data. Many an evaluation can be hampered by the sheer volume of data to be transcribed and input for analysis.
- Keep the questionnaires anonymous as this will enable a freer response than if the students can be identified, in which case they might not be as forthcoming.
- As questionnaires are less time consuming to administer than other instruments of evaluations try not to over use them. Students can become uncooperative if every time they do something they are presented with a questionnaire.
- Take into account the advantages and disadvantages of using questionnaires.
- **Above all pilot the questionnaire before using it on your target group.**

Advantages

- Covers a lot of information in a simple format.
- Allows for anonymity, perhaps eliciting more genuine responses.
- Fairly simple to administer.
- Easy to collate and analyse.

Disadvantages

- Difficulty in getting a useful response rate (not everybody returns the questionnaire).
- Open ended questions are more difficult to categorise.
- Responses may be based on the more memorable events (either good or bad).
- Any follow-up must be done through interviews.
- Necessary to keep the questions focused and to ask the right kind.
- Can become merely "feel good" tick sheets.

Semi-structured Interviews

This evaluation is best used after you have collated and analysed your questionnaire. This will then allow you to obtain an elaboration on important points arising out of your questionnaire. It even allows you the opportunity to cover those points you did not manage to cover in the questionnaire.

Developing your interview questions

While developing your questions from points arising out of your questionnaire do not feel confined by these, allow the interviewees to raise points of concern to them about the learning event. By so doing you may discover points that you yourself had not thought of. However, do not allow yourself to be side-tracked too much.

- Do not forget that interviews tend to collect a lot of data by sticking to your prepared and scripted questions and keeping your interviewee(s) focused you will resist collecting too much unwanted data.
- Interviews may be conducted individually or in groups. One of the benefits of group interviews is that one comment may encourage others.

Advantages

- Allows for elaboration of answers.
- Potential for revealing points not previously considered.

Disadvantages

- Takes time to arrange the interviews and to conduct them.
- Potential for collecting too much data, some of which may be unwanted.
- Analysing the responses.

Confidence Logs

These were developed by the TILT Project (University of Glasgow) and are extremely useful in gauging a student's confidence on particular points of a given subject area. These are useful as self indicators of learning rather than anything more concrete. Although their relationship to the actual learner is unproven they can be a useful guide to a student's self-appraisal of his or her own knowledge. It is beneficial within a learning event if the learner's confidence is higher in order that they may actually learn. Under confidence as much as over confidence can be an inhibiting factor as a foundation for learning.

Example:

This is taken from an evaluation carried out on a piece of software produced by a TLTP Economics consortium. The Confidence Logs demonstrated an increase in the learners self-assurance with the material. On average their confidence moved from a feeling of "Some-Confidence" to that of "Confidence". Although this does not necessarily translate into increased attainment scores it is a necessary element to any learning environment.

	Very Confident	Confident	Some Confidence	Little Confidence	No Confidence
Pre	0	4	11	2	2
Post	1	12	4	1	0

Table 1: Confidence Logs

1Crichton (1995), cites Belcha (1992), in her preliminary observations of an earlier version of *WinEcon* states that "the subjective measure used here has the strength of reflecting a student's own judgement about whether or not the software was helpful in learning course material.".

Observations

Again, as with any instrument the better prepared and the more focused an observation is the more likely it is that useful data can be collected. Although with video-taped recordings it is possible to make observations at a later date, it is far better to have a sense of what one is seeking to observe whether it be inter-personal communications, skills or behaviour patterns (e.g. study strategies - note taking, etc.)

Use of a structured observation sheet is essential whether the session is video-taped or not. If video-taping is not possible, then the use of a tape-recorder is useful as students verbal interactions and comments may be synchronised with the notes and comments from the observation sheets.

It is useful to have a code or shorthand that can help in recording your observations. This will help you focus on what it is that you are trying to observe while at the same time allowing for those unexpected but enlightening events which may occur. If you are conducting the observation exercise with a colleague make sure that you are both clear on the meaning of the shorthand code.

Example:

This particular observation sheet was created for use in the evaluation of a piece of Japanese CAL software. A pair of students were video taped using the program and their actions were noted on the observation log when the tape was later analysed.

Evaluation Exercise

Date: **Institution:**

Lecturer: **Evaluator:**

Hardware: **Program:**

Student Name(s): **Time:**

Observation Log

CODE for interactions:

TS	=	Teacher to Student	**SS**	=	Student to Student
GD	=	Group Discussion	**SC**	=	Student to Computer
GC	=	Group to Computer	**SI**	=	Student Individually

#	Time	Code	Comment

Student Profiles

It is useful to start any evaluation by obtaining a profile for each student as a baseline against which any future changes in both attitude and opinion may be referenced. Within a Student Profile questionnaire it is appropriate to ask about the learner's attitude towards computer-based learning as well as their use of computers in general. At the same time, questions concerning the learner's academic background in the particular and related areas of

the content subject under evaluation. If for instance in an evaluation programme on CBL in economics, information about the learner's level of knowledge of not only economics (e.g. Standard Grade or Higher, O or A levels etc.) but in the related areas of maths and statistics would be useful.

Profiles are also useful when selecting evaluation groups by the use of stratified random sampling through which it is possible to obtain groups of learners that meet specific criteria. When wanting to make sure that there is a range of student abilities in a certain group the use of a student profile questionnaire can be used as a basis for this selection.

Pre and Post Tests

This is perhaps one of the most difficult techniques in terms of educational research. The idea of performing a pre-test before the students use of a particular program followed by a post-test in order to measure any educational gain is not as simple as it might first appear.

The concern is that of test validity which is fundamental to the purpose of any testing. Cohen and Manion (1980) raise the point that:

> *"Conditions that threaten to jeopardise the validity of experiments... are of greater consequence to the validity of quasi-experiments (more typical in education research) than to true experiments...."*

The problem is one of both 'internal validity' and 'external validity.'

Internal validity is concerned with whether the educational intervention makes any difference to the outcome in question. Whereas external validity is concerned with how far the results are generalisable and in what settings and with what population. There are different factors which affect validity which fall outside the scope of this article. However one of the main problems within higher education is that it is becoming increasingly difficult if not time consuming to create a 'true' experimental design.

Notwithstanding the potential pitfalls and accepting the limitations of this technique indicators of learning gains may be obtained, and while not being generalisable may be useful when taken together with other findings.

Example:

This example is once again taken from the evaluation of the economics software package *WinEcon* together with *Economics in Action* and the two recommended coursebooks that these software programs are based on. The students were randomly split into three groups and each group were given a different learning resource for each test. They were tested at both the beginning and at the end of each session.

	TEST 1	**+/- %**	**TEST 2**	**+/- %**	**TEST 3**	**+/- %**
Group 1	WinEcon	+11.11	EIA	+10.83	Books	+11.31
Group 2	EIA	+11.81	Books	+10.00	WinEcon	+8.57
Group 3	Books	+25.69	WinEcon	+17.00	EIA	+2.04

The pre- and posts-tests results appear to indicate that the software was certainly no worse than more traditional forms of book-based learning. The first test appeared to indicate that the possible automatic note taking by the students seemed to have had a beneficial impact which is somewhat equalised as all the students adopt this approach in the subsequent two tests when using either piece of software.

A one-way analysis of variance was carried out on the data in order to identify whether any group was better at economics. The pre-test scores of each group were subjected to this analysis but there were no significant differences. The nearest to any effect occurred in Test 1, though this was not statistically significant. No matter which media was used the students performed equally well, however, with such a small sample small changes in performance were undetectable.

Checklists

It is useful to document all aspects of the evaluation procedure and check this off once completed. Tessmer and Harris (1992) make great use of checklists as templates for conducting evaluations. Having a checklist of the stages within an evaluation can help in the shaping and structuring of the overall evaluation design, besides their use in the evaluation itself.

The TLTP project TILT have developed a useful checklist of all learning resources available to students. At the end of a course or programme the students complete the checklist indicating what they found useful. It could include such resources as books, handouts, tutor's time, other students, CBL packages etc.. This is useful in indicating those resources which a student uses and finds most helpful over the period of a course.

Another excellent of source is the "Telematics Applications for Education and Training USABILITY GUIDE, Version 2" by Smith & Mayes (1995) as it contains references to other evaluation sources. It is freely available over the world wide web via URL "http://www.icbl.hw.ac.uk/tet/usability-guide/".

Example:

This checklist can be used when initially planning an evaluation in order to begin to create an evaluation plan. It could then be written up as the basis for a contract, either formal or informal, for any evaluation work to be performed.

INITIAL EVALUATION ASSESSMENT CHECKLIST

Who? (Target — know your audience)
Who is the evaluation for?

What? (Area — understand what it is you are evaluating)
Process (Efficiency)
Outcome (Effectiveness)
Combination of both (Relevance)
Purpose (Validate, Improve or Condemn)

When? (Timing — don't start until you are ready)
have you defined a question?
will the findings have any effect?
benefits outweigh costs

How? (Techniques — what is most appropriate)
Questionnaires
Interviews
Confidence Logs
Observations
Student Profiles
Pre-Tests and Post Tests
Inventory Learning Checklists

Summary

The effort that is put into the design of any piece of evaluation will pay rich dividends, however, defining the right question is always the key starting point. There are degrees of correctness of definition but this should always be something that is measurable and possible within the time frame in which you are working. Each evaluation will have its own combination of costs and benefits (see Breakwell and Millward, 1995), and estimating them is all part of the work of an evaluation.

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Forsyth, Ian, Jolliffe, Alan and Stevens, David (1995) *"Evaluating a Course"*, Kogan Page, London

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Tessmer, Martin (1993) *"Planning and Conducting Formative Evaluations"*, Kogan Page, London

The evaluation instruments referred to in this chapter are included in Appendix 2.

Evaluation is also addressed in the following chapters: Chapter 11 - a conceptual introduction; Chapter 3 - the role of evaluation in the overall process of implementation, and Chapter 7 - a practical guide on how to evaluate LT materials that you may be considering using in your teaching.

13: Where do we go from here? Postscript and further information.

Editor's postscript

Hopefully you will have found the contents of Implementing Learning Technology interesting and useful and you will want to go further - to embark on a new implementation, to review existing usage of learning technology or to plan an evaluation of the use of technology in teaching. So, where do we go from here?

Based on the principal that we learn best from our mistakes - or at least from active participation - the best place to start is probably to get involved in the process of planing and implementing technology into your own teaching. It would be unrealistic to suggest that this is an easy task, but teaching rarely is. However integrating technology can be very rewarding - for both you and your students - and need not be as daunting as it might appear at first sight. In general the technical expertise required to use existing learning technology in your teaching is relatively low and there is a wealth of useful material available.

This publication is not the place to list the subject/domain specific learning technology materials. However there is a lot of courseware available, much of which has great potential value in teaching and learning. In addition to commercial software, a great deal of material has been produced under public funding in the UK. Most of this material is available to UK higher education institutions at very low cost. Further information on these projects and initiatives is included in the LTDI Information Directory, as are details of the subject specific CTI Centres - good sources of advice on the availability of public sector and commercial learning technology materials.

Of course another place to go to next is to LTDI. We offer a range of services, including implementation help, all of which are free to Scottish HEIs

The remainder of this chapter lists some resources that may be useful to you in the process of implementing learning technology into your teaching and evaluating the efficacy of your implementations. The first section is an annotated bibliography of a selection of reports, articles and books. The second section lists some of the most relevant journals in this area. Useful World Wide Web URLs are listed in the LTDI Information Directory and are available from the LTDI Web site at http://icbl.hw.ac.uk/ltdi/.

An annotated bibliography

CTI (1992) 'Computers in University Teaching - Core Tools for Core Activities. A report from the computers in teaching initiative.' CTISS Publications.

Concise report looking ahead to Higher Education in 2000 and the likely role for technology. Illustrated with analysis of current position subject by subject.

CSUP (1992) 'Teaching and Learning in an Expanding Higher Education System - report of a working party of the committee of Scottish University principals'. Known as "The MacFarlane Report"

Significant report which has been the catalyst for much change and more debate about the role for technology in teaching and learning, particularly within Scotland. A clear insight into the challenges facing higher education in Scotland and the role of technology in meeting them.

Crook, Charles (1994) 'Computers and the collaborative experience of learning' Routledge, London

An interesting text on the use of technology in teaching which draws on cognitive psychology, discusses educational technology from a socio-cultural perspective & concludes on the importance of collaborative experience in the teaching and learning process.

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A directory of the main UK public sector initiatives and projects related to information technology and teaching in the higher education sector.

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Invaluable and comprehensive source of information for courseware developers.

Whittlestone K, Howe G & Longstaffe A (1993) 'Getting Started with Computer Based Learning'.

A short booklet aimed at absolute newcomers to learning technology.

Relevant journals

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Computers and Education: Centre for Academic Practice, University of Strathclyde, Glasgow, G1 1QE

Journal of Computer Assisted Learning: Prof R Lewis, Dept of Psychology, University of Lancaster, Lancaster LA1 4YF

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Appendices

Appendix 1: UseIT

This appendix is a reproduction of the LTDI leaflet "UseIT".

Rupert Loader & the 1994/95 LTDI team

This document presents a series of suggested considerations for academic staff in Higher Education who may want to use information technology (IT) in their teaching. It is intended as a guide to the use of learning technology (LT) materials only: further information is available from LTDI or the other sources listed.

This document should help you to:

- decide whether or not to use IT in your teaching
- assess some of the advantages and disadvantages of using IT in teaching
- identify good CBL materials
- make sure you have considered all hardware and software issues
- identify some of the problems and pitfalls which may occur
- identify some of the main issues which will face your institution
- convince yourself, your colleagues, and your students

So you're thinking about using CBL...

'What do I need to consider before I begin?'

A few challenges facing you and your teaching

- the drive to improve the quality and effectiveness of teaching
- the problems of time, and the balance between research, other activities, and teaching
- the need to increase the attractiveness of courses in the face of 'competition' in the 'market'
- the need to cater for greater numbers of students, from varied backgrounds, and to broaden access (and to offer non-traditional entry methods) to courses, and to support different forms of transfer into HE
- the need to provide more flexible patterns of learning
- the desire to keep up with technological developments - for example e-mail and the Internet
- the expectation of students that you will be ace researcher, top manager and brilliant orator rolled into one

What are the broad aims of the course or module?

- to train students in a range of subject specific techniques
- to enable students to develop practical skills
- to encourage students to participate actively in learning and to fully understand material
- to help students learn and remember a series of facts
- to encourage students to work collaboratively and to discuss and argue issues and cases
- to encourage students' interest and competence in using IT methods

What are your own aims and objectives in considering using IT in your teaching?

- to enhance teaching
- to enable students to learn better or faster
- to save time for research
- to save time for assessment
- to save time for better teaching
- to save other resources
- to cater for more students

What benefits can using technology in teaching bring to me as a lecturer?

- if the CBL is used well, students should react positively towards it
- CBL can help in the flexible delivery of teaching to large numbers of students
- students learn material effectively with potential savings in time
- assessment and other marking duties may be reduced
- communication with students and colleagues may be improved
- there may be less routine enquiries to deal with
- students can become more responsible for their own learning
- some IT resources give access to documents, images, or information which would otherwise be expensive or impossible to obtain
- students can potentially learn at a remote site - or from home

- IT use is encouraged by Teaching Quality Assessment
- using IT in teaching should help you develop your own IT skills

What benefits can CBL deliver to my students?

- they can work anonymously at their own pace
- CBL usually enables them to learn (inter)actively, and encourages them to *do* things, and to become involved in their own learning process
- they usually get instant appropriate feedback
- they usually find CBL interesting, varied and fun
- they can work with real examples and/or practical cases
- they can access a huge range of varied information
- graphics, sound, animation/multimedia offer students a visual and dynamic environment in which to work
- students can explore problems and obtain help in a non-linear fashion, thus encouraging them to investigate and see problems in different ways
- students should be able to understand and solve problems more creatively
- students will learn about IT, and feel they are studying in a positive modern department

What benefits might accrue to the institution as a result of using CBL

- teaching costs (in the long-term) may be reduced
- staff will be able to cater for increasing numbers of students
- improvements will accrue to the institution's image and marketability to students and funders
- improved quality assessment ratings
- flexible use of space and time
- opportunities for development of distance learning programmes
- good CBT fits in well with modularisation

Software types and styles you might consider using...

- drill and practice, where students practice particular activities having been prompted by exercises questions on the computer
- microworlds or games, where students become part of a computer-based 'world' or problem-solving environment simulating reality
- practicals, where the software simulates physical activities which might otherwise be carried out in a practical laboratory, and which might otherwise be expensive or dangerous
- simulations, where the computer attempts to simulate real events and allows students to alter or become part of the real or imaginary situation
- tutorials, where the software leads the student through a series of steps, much as a human tutor might
- analysis or modelling tools, where the computer offers tools for students to build their own analyses or models
- information retrieval, where the software (often on CD-ROM) allows access to a huge range of information
- on-line software, offering access to the Internet and the World Wide Web
- communication tools, where students and staff can communicate effectively using e-mail and conferencing
- presentation software, to enhance your teaching and presentations
- more general assessment or study skills software

Things you should consider about hardware provision

- which platform - Macintosh, PC-compatible, or other - such as UNIX?
- what machines are available in various locations - on your desk, in laboratories/University clusters, students' rooms or halls, lecture theatres, your own department?
- what are the technical capabilities of the machines - how much random access memory (RAM) and hard disk (HD) space do they have; what monitors do they have ((S)VGA?); what peripherals, such as CD-ROM, sound and printers do they have?
- are the machines networked, and how much access to the students have to network software and hardware?
- can the machines be moved, or the layout changed, to suit your own requirements?
- how great is the demand for network facilities, such as printing, and at what cost to the department or students?
- can students gain access to machines for private study if required?
- do you have access to amenable and supportive technical assistance?
- how far ahead do you need to book computer facilities and technical staff?

Other resources you may need...

- academic support from colleagues, research assistants and postgraduate students
- administrative support
- technical support
- equipment and facilities provision
- facilities and personnel for altering (or publishing) CBL materials
- duplication (of disks etc.) facilities
- security arrangements
- an increased budget (to purchase materials in the short-term)

A few initial problems you may encounter

- lack of facilities
- the choice of software may not suit you
- a high workload in the year you adopt the CBL - adapting to new methods and integrating the materials
- you may encounter technical problems
- computer rooms may seem noisy

- students' problems may be repeated at different times as they work at their own pace
- if students become demotivated they may miss crucial sessions
- negative attitudes from colleagues
- organising the CBL activities

Deciding on what CBL you are going to use...

'There's a lot out there, so choose carefully'

A few characteristics of good CBL materials to look for (most packages have a number of these):

- it should be well-designed and presented with a consistent look and feel
- it should be relatively quick to learn and easy to use
- the software should be navigable - users should never feel 'lost' when using it
- the software should be tailorable - easily if so advertised
- the software should make best use of the computer's strengths - calculations, graphics and interactions - and not carry too much text
- the software should be easy to set up
- the software should carry relevant and usable help facilities
- the software should be accompanied by relevant and usable documentation

Where can I obtain software from?

- Teaching and Learning Technology (TLTP) projects
- commercial sources
- public domain sources
- Information Technology Training Initiative ITTI
- sources within your institution or various private individuals
- DIY

Where can I obtain advice on using and implementing CBL?

- your institution's IT Officer, Teaching and Learning Service, Computer Services or Staff Development Service
- the 22 Computers in Teaching Initiative (CTI) Centres
- the Computers in Teaching Initiative Support Service (CTISS)
- the Learning Technology Dissemination Initiative (LTDI)
- the TLTP projects
- the TLTP regional centres
- Various World Wide Web (WWW) sites

Types of integration of software into courses

- use the CBL materials in a laboratory or computer room (either supervised or unsupervised) as a tutorial substitute
- use the CBL materials in a laboratory or computer room (either supervised or unsupervised) as a (partial or complete) lecture substitute
- use the CBL materials to substitute for practical work
- encourage students to make use of CBL in their own time - self-study access for remedial help or revision
- use CBL as a tool/forum to prompt discussion in seminars
- use CBL as a (information) resource for group or project work
- use CBL as an analytical or diagnostic tool
- use CBL primarily for assessment
- use parts of CBL materials for demonstrations in lectures
- use CBL as a running game or simulation over several weeks or modules

Some broad issues of course re-design to consider

- full integration of CBL into the course is vital
- know and plan for the genuine level of computer literacy of your students
- test the materials on a small group of students in the first year
- prepare dedicated handouts or worksheets to encourage CBL usage
- add computer references to reading lists
- is what you are planning pedagogically desirable, and planned into the rest of the curriculum?

A few practical aspects to consider

- try the software on the machines to be used with students, not just the one on your desk
- be prepared for problems to occur
- is what you are planning technically feasible?
- try to obtain some departmental control over CBL facilities

A few initial assumptions to avoid

- that colleagues will share your enthusiasm - but do offer to share your experiences with them
- that students in the computer game era are computer literate and confident
- that your colleagues are computer literate and keen
- that CBL will be used because it is there - it must be properly planned into the course
- that CBL will replace you or lectures - it cannot

Practical Issues of Implementation

'What do I actually do?...'

Discuss with others in the institution

- course leaders or your Head of Department
- staff development officers
- Teaching and Learning co-ordinator or IT subcommittee
- LTDI contacts
- TLTP contacts or consortium members

Investigate hardware and space

- technical facilities
- numbers of students
- availability and scheduling of space
- availability and numbers of machines
- availability of spare machines

Re-design parts of the course

- discuss with students
- discuss with colleagues
- discuss with course committees and validation bodies
- amend the software
- prepare worksheets and other accompanying materials
- test worksheets and accompanying materials
- arrange for team teaching or demonstrators

Selling the idea to students

- when first running the software, tell them they are part of a trial group and request feedback - then listen to it and act on it
- offer an introductory session for those with no previous IT experience, or offer them full details of any centrally-run courses
- tell the students they will gain from using computers and offer them clear aims
- tie the computer sessions closely to the lectures
- assess the materials delivered by the computer (either by machine or with subsequent exercises)
- only include relevant computer materials
- tell them how, where and when they get can get help with using the materials
- tell them it is a new, exciting and dynamic way to learn
- get them involved in more general ways - for example by setting up e-mail discussion lists for the module group and encouraging them to contribute

Some of the most common student attitudes to prepare for...

- I don't like computers
- I don't know how to use a computer
- I know all about computers - so I'll press this key combination (whoops!) (or just play games)
- I've done this before
- this is fun - much better than lectures
- this is not real work - it just lets staff off lecturing - it is not difficult and it is not important
- it is too difficult - struggling with the computer and the material
- we won't have this computer package in the real world - we cannot take it away with us like we can a textbook (for future reference)
- we can't get into the labs - they are fully booked and not open at weekends or in the evenings
- sorry - I couldn't do the assignment because the computer crashed just as I was going to save my work
- backups - what are they?

A few staff attitudes you may encounter

- computing is not our area - we are teachers of ...
- we should be teaching them DOS and UNIX - this is not real computing (correct)
- computing is the preserve of technical staff - I'm a lecturer
- how do you know which student does the work
- what is wrong with the way we have taught this course in the past?
- does it really save time and other resources?
- it is a very impersonal way of learning
- what would I do if the machines went wrong?

Concluding Issues

'A few words of wisdom and encouragement...'

- know your students - make sure the CBL system is what they need
- know the software - well
- be enthusiastic
- be the facilitator
- provide encouragement
- learn when to intervene
- set targets and deadlines
- be led by the teaching, not the technology
- evaluate thoroughly
- focus on disciplines
- attend to standards
- reflect and adapt
- know where to get help
- be confident and flexible - and **enjoy IT!**

Appendix 2: Evaluation Instruments

This appendix provides examples of the various types of instruments that can be used in the evaluation of learning technology and/or its implementation. The majority of these instruments are generic in their nature and could be used as they are in a variety of different evaluation exercises, a few are more subject/situation specific. ***You may freely copy and/or adapt any of these instruments for use in your own evaluation exercises provided this publication is acknowledged in any publications arising from their use****. We thank the originators for permission to reprint these examples in this publication.*

Some of these instruments are referred to in the chapters dealing with practical evaluation issues (as noted below), others are reproduced as examples of the types of instruments that may be used in evaluations.

Contents of Appendix 2

First Step Evaluation 'Checklist'

A Guide for reviewing a new piece of software

Rather than considering a piece of learning technology in isolation it is important to think about the aims and objectives of a piece of software relative to its planned usage. For example, if one of the aims of a course is to encourage your students to relate different subject areas together you might feel that a piece of software does not quite fulfil your needs but the same software used in association with some paper based problems or as part or a group project might be far more effective.

This Checklist is designed to act as a guide to be used when reviewing a piece of software for the first time. Aspects of technical and systems support are not included but are also important considerations prior to the implementation of any of the learning technologies.

Part 1 - some points to consider as you work through

◊ **How easy is it to navigate your way through the software ? Does the package have a clear structure ?**

◊ **By what process is the user expected to learn about the subject as they work through the package ? Is this a good way of teaching this subject ?**

◊ **How do the learning strategies encouraged in this software fit into those of your existing courses and related teaching and learning materials ?**

◊ **What background knowledge or additional support would be required by your students if they were to use this package?**

◊ **Could you customise the package to suit your course requirements ?**

Part 2 - A step by step guide

This part of the checklist is designed to focus on different aspects of a new piece of software, as they might be encountered by a first time user. Therefore, you are asked to stop and review the package at certain points as you go through.

INTRODUCTION

Look through the introduction to the package

(this might be several screens or paper based material).

First Impressions

Are you presented with :	YES	NO
an explanation as to how you might use the package.	____	____
a series of topics in a menu format	____	____
some navigational hints about finding your way through the software	____	____
no introduction, you are straight into the first section	____	____
other (please specify)		

How much information is provided relating to the academic content of the package?	YES	NO
Is there an outline of how the material is structured or to be prioritised ?	____	____
Are the objectives of the package clearly laid out ?	____	____
Is there an indication as to level of prerequisite knowledge required ?	____	____
Are there links made to other relevant sources of information ?	____	____
Can you select from different sections according to difficulty ?	____	____
Do you know what to expect next ?	____	____
Other (please specify)		

Is some background knowledge of how to use a computer necessary before using the package ?	YES	NO
	____	____

Do you feel encouraged to work through the package ?	YES	NO
	____	____

INTO THE FIRST SECTION

Move on through the next few screens and into one of the sections.

Level of User Control and Interaction

What level of interaction is required to move through the package i.e. are there a range of responses required or do you just press the return key?

High interaction				**Minimal interaction**
5	**4**	**3**	**2**	**1**

Can you control the rate at which you move through the package? **YES** **NO**

____ ____

From your current screen can you (*please tick*):

____	exit the programme	____	go back to the beginning
____	go forward a screen	____	go back a screen
____	move to a main menu	____	change to another section
____	save a copy of your work, so far, to file	____	print a copy of the screen
____	modify the material to suit your needs	____	refer to another section and
____	use a calculator		return to the same point
____	take notes into a scrapbook/notepad	____	other (please specify)

Which of the above functions would you say was the most important ?

Package Design and Layout

How much information is presented on each screen at one time ?

too much					**too little**
5	**4**	**3**	**2**	**1**	**0**

How clear is the on screen presentation i.e. graphics, text etc. ?

very clear					**difficult to see**
5	**4**	**3**	**2**	**1**	**0**

If graphics are used on screen - why are they used ?

Are they really necessary ?

If graphics are not used on screen - would supplementary graphics be beneficial ? **YES** **NO**

If so, can you suggest some possible sources e.g. software libraries, books etc. ?

MID - SECTION

Move forward a few screens

Prioritisation and presentation of information

How do you differentiate between the relative importance of pieces of information on a screen ?

How are key words in the text highlighted ?

Just by looking at a screen would it be possible to identify whether or not you were looking at a main, sub-menu or a help screen etc. ? **YES** **NO**

Have you any comments regarding the colour, font and the type style used so far?

How many icons appear regularly on the screens. Can you describe each of their functions?

	Screen Icon	Function
1.		
2		
3.		
4.		
5.		

Provision of student support

If you require assistance, is a help facility available from your current screen? **YES** **NO**

If so, how is the help facility accessed ? i.e. via a menu or icon, highlighted words etc.

What kind of help is available ? (*tick those available*)

____ navigational
____ meanings of key words/information
____ alternative strategies
____ a glossary
____ other (*please specify*)
____ additional useful information
____ worked examples
____ reference to other material
____ content based material

Which of the above help facilities do you think is the most important ?

END OF FIRST SECTION

Move on to the end of this section or unit of the package

Matching strategies with objectives

As you worked your way through the section did you feel that :	**YES**	**NO**
the information was being related to your existing knowledge	____	____
you were being encouraged to think more about the subject area	____	____
your interest was being maintained through use of a range of strategies	____	____
the courseware was responsive to your own particular learning needs	____	____
material was structured in a way that facilitated an overall understanding	____	____

any other general comments ?

Feedback support for users

Was there any feedback provided as you were working through the software? e.g. on your rate of progress, performance etc. **YES** **NO**

If so, in what form did this take ?

Do you think this form of feedback is useful ? **YES** **NO**
Would you say that you felt encouraged to obtain feedback ? **YES** **NO**

Assessment

Were you assessed while you were working through the section? **YES** **NO**

If so when ?

Were exact responses required in the assessment ? **YES** **NO**
What would you say these assessments were testing ?

____ factual recall
____ your ability to guess
____ your ability to relate pieces of information together
____ other

___ your overall understanding of the subject
___ whether or not you had solved a problem
___ your creativity
___ the attainment of the package's objectives

Can you move to the next topic without completing the assessments ? **YES** **NO**
Did you obtain any feedback on your assessment responses ? **YES** **NO**
If YES, was the feedback only related to the wrong answers ? **YES** **NO**
Were your errors explained ?
Was the feedback constructive ? **YES** **NO**

Moving between sections

From the end of each section can you ?

____	exit the programme	____	go back to the beginning
____	move to a main menu	____	change to another section
____	save a copy of your work to file	____	print out selected information
____	take notes into a scrapbook/notepad	____	see the point reached in the programme and what is left to do
____	go to some form of assessment		
____	go to a more/less difficult section	____	obtain a summary of the section
____	stop and then return to this point later	____	other (*please specify*)

WHEN YOU HAVE FINISHED LOOKING THROUGH

Was the information contained in the package correct in terms of factual content ? **YES** **NO**

Draw a diagram of how you perceive the structure of the package.

How long do you think the package is :

____	in terms of the number of screens ?	____	the student time to complete ?

How would you envisage this package might be used ?

____	remedial assistance	____	flexible learning
____	as part of a group project	____	as part of a tutorial
____	in a class with supporting material	____	other

Do you think the subject area benefited from the use of technology ? **YES** **NO**

Was the learning strategy reflected, appropriate to the learning objectives of the package? **YES** **NO**

Does the software test that its objectives have been attained? **YES** **NO**

IN SUMMARY

Having reviewed the package how would you rate the package in terms of :

Usability

excellent **poor**
10 9 8 7 6 5 4 3 2 1

What kind of additional support would be required for a student to work through the package by themselves ?

Layout

excellent **poor**
10 9 8 7 6 5 4 3 2 1

Is it possible to customise the package to suit your course requirements ?

Academic Content

excellent **poor**
10 9 8 7 6 5 4 3 2 1

Could this package be used as part of one of your courses ?

If so - HOW ?

If not - WHY NOT ?

Attainment of Learning Objectives

excellent **poor**
10 9 8 7 6 5 4 3 2 1

Which of the following best describes the type of approach you were encouraged to adopt as you worked through the package ?

____ deep approach (looking to an overall understanding of the material)

____ strategic approach (driven towards high attainment i.e. not to make mistakes)

____ surface approach (minimal interaction, no need to understand material)

How do the learning strategies encouraged in this software fit into those of existing courses and related teaching and learning materials?

Pre and Post Intervention Questionnaire

Date:	**Department:**
Lecturer:	**Evaluator:**
Hardware:	**Program:**
Student Name:	**Time:**

SECTION A: Pre-Program Questions

Students should complete this section before using the software.

1. What are you expecting to learn from today's session ?

2. (a) Are there any parts of this subject area which you have difficulty with ?

2. (b) How do you hope that this session will help you ?

Do not answer any of the other questions until after you have used the software.

SECTION B: Post-Program Questions
Students should only complete this section after using the software.

1. What do you feel was the most important thing that you learned today ?

2. Look back at what you wrote for the Pre-Program Questions and note down below:

(a) What you have learned and compare this with what you had hoped to learn

(b) what you did not learn that you had hoped to:

(c) was there anything that you learned that was unexpected:

SECTION C: Software

1. To what extent do you agree with these descriptions of the computer program?

(1 = Strongly Agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly Disagree)

	Please circle one				
Easy to use	**1**	**2**	**3**	**4**	**5**
Enjoyable to use	**1**	**2**	**3**	**4**	**5**
Provides good support for the exercise	**1**	**2**	**3**	**4**	**5**
Provides good advice on how to work through the material	**1**	**2**	**3**	**4**	**5**
Helps you learn about the subject	**1**	**2**	**3**	**4**	**5**
Fits well with the rest of the course material	**1**	**2**	**3**	**4**	**5**
Well worth the time spent on it	**1**	**2**	**3**	**4**	**5**
It would help me to revise the subject	**1**	**2**	**3**	**4**	**5**
I would use it, in my own time, again	**1**	**2**	**3**	**4**	**5**

Please add any other comments you wish

2. This program is meant to help you improve your knowledge of /skill in_____*(the subject)*.
Could you please comment on any improvements you are aware of in:

(a) your general knowledge of _____*(the subject)*

(b) the way in which you approach _____*(the subject*

(c) the way in which you might apply what you have learned in the future

Thank you for your time and effort in completing this questionnaire

Program Questionnaire

Please tick the box [✓] for those characteristics of the program you feel are well designed, and put a cross [X] against those you feel need improving, together with a comment.

1. Navigation

Clear what options are available to you [ ] _____

_____

Easy to get where you wanted to go [ ] _____

_____

Easy to find out what you have completed already [ ] _____

and what is still to be completed _____

2. Interface

Easy to understand functions, menus, icons etc. [ ] _____

_____

Terms and procedure for navigation are consistent [ ] _____

_____

Screen easy to read, pleasing to look at [ ] _____

_____

3. Interaction

Presentation sufficiently informative [ ] _____

_____

Presentation interesting [ ] _____

_____

Content is - challenging [ ] _____

_____

right level for the course [ ] _____

_____

Feedback provided enabled you to learn better [ ] _____

_____

Clear about what you had to do [ ] _____

_____

Clear what you have achieved [ ] _____

_____

4. General

Please add any other comments you would like to make about the computer program.

Thank you for your time and effort in completing this questionnaire.

Software Usability Evaluation

Package:	**Strongly agree**					**Strongly disagree**
I found this package easy to use	**1**	**2**	**3**	**4**	**5**	**6**
I would like to use this package again	**1**	**2**	**3**	**4**	**5**	**6**
I would feel confident using this package with students	**1**	**2**	**3**	**4**	**5**	**6**
I think my students would enjoy using this package	**1**	**2**	**3**	**4**	**5**	**6**
I think my students would benefit from using this package	**1**	**2**	**3**	**4**	**5**	**6**
I think that my students would find this package easy to use	**1**	**2**	**3**	**4**	**5**	**6**
I think that the material in this package would be challenging for my students	**1**	**2**	**3**	**4**	**5**	**6**
I think that this package contains material similar to my course content	**1**	**2**	**3**	**4**	**5**	**6**
I think that this package contains material that is desirable pedagogically	**1**	**2**	**3**	**4**	**5**	**6**
I think that this package could be a useful tutorial aid	**1**	**2**	**3**	**4**	**5**	**6**
I think that this package could be a useful lecture aid	**1**	**2**	**3**	**4**	**5**	**6**
I think that this package could be used as part of students' directed study	**1**	**2**	**3**	**4**	**5**	**6**
I think that this package could be useful for students encountering difficulties with the subject	**1**	**2**	**3**	**4**	**5**	**6**
I think that this package could be a useful revision aid	**1**	**2**	**3**	**4**	**5**	**6**
I think that this package could easily be integrated into my course	**1**	**2**	**3**	**4**	**5**	**6**
This package could be useful for more than one course	**1**	**2**	**3**	**4**	**5**	**6**

Student Confidence Log

If you have not as yet had a lecture on this course material, you might think it inappropriate to say anything at all about your understanding of the topics below before working through the program. However, completing this form will give us baseline data for describing any changes in confidence levels which may be found following the use of this program.

Please indicate by ticking [✓] in the relevant box, how confident you feel about your understanding of the concepts or development of the skills listed below.

Date: **Department:**

Lecturer: **Evaluator:**

Hardware: **Program:**

Student Name: **Time:**

A: Pre-Program Confidence Levels

Concepts / Skills	Very Confident	Confident	Some Confidence	Little Confidence	No Confidence

B: Post-Program Confidence Levels

Do not complete this table until <u>after</u> using the program.

Concepts / Skills	Very Confident	Confident	Some Confidence	Little Confidence	No Confidence

Observation Log

(page -_____/___1_)

Date: **Department:**

Lecturer: **Evaluator:**

Hardware: **Program:**

Student Name(s): **Time:**

CODE for interactions:

TS	=	Teacher to Student	**SS**	=	Student to Student
GD	=	Group Discussion	**SC**	=	Student to Computer
GC	=	Group to Computer	**SI**	=	Student Individually

#	Time	Code	Comment	Note

Observation Log (page -_____/_____)

CODE for interactions:

TS	=	Teacher to Student	**SS**	=	Student to Student
GD	=	Group Discussion	**SC**	=	Student to Computer
GC	=	Group to Computer	**SI**	=	Student Individually

#	Time	Code	Comment	Note

Economics Profile Questionnaire

This questionnaire has been designed to gather information about the first year Economics course. Please try to answer all questions honestly.

Please tick the boxes as appropriate

1. Sex a) Male ☐ b) Female ☐

2. What age group are you? a) 27 or under ☐ b) 28 and above ☐

3. Have you studied Economics before e.g.Highers? a) Yes ☐ b) No ☐

4. How would you rate your Mathematical ability?

a) University level ☐ b) A Level/Higher ☐ c) 0 Level ☐ d) Beginner ☐

Below are some statements about computers. To what extend do you agree with them?

6. “Given a little time and training anybody could learn to use a computer.”

a) strongly agree ☐ b) agree ☐ c) neutral ☐ d) disagree ☐ e) strongly disagree ☐

7. “I find a computer difficult/complicated to use.”

a) strongly agree ☐ b) agree ☐ c) neutral ☐ d) disagree ☐ e) strongly disagree ☐

8. “Computers isolate you from other people.”

a) strongly agree ☐ b) agree ☐ c) neutral ☐ d) disagree ☐ e) strongly disagree ☐

9. “I think computer literacy will make me more employable.”

a) strongly agree ☐ b) agree ☐ c) neutral ☐ d) disagree ☐ e) strongly disagree ☐

10. “I am afraid of looking silly if I make a mistake while using the computer.”

a) strongly agree ☐ b) agree ☐ c) neutral ☐ d) disagree ☐ e) strongly disagree ☐

11. Name and Student No.

Please return the completed form to _____, by _____.

Thank you very much for your time and effort.

If you would like to take part in a research project into evaluating the economics package WinEcon, please make sure that you have filled in your name and student no. There will be a payment make to those students willing to assist in this research project.

Appendix 3: Contributors

Kathy Buckner

Kathy joined the LTDI team in August 1995 as Implementation Consultant for Health Sciences. She is on part time secondment from the Department of Communication and Information Studies at Queen Margaret College, Edinburgh where she is a lecturer in Information Management and Technology. Kathy has various research interests including the development and use of computer based learning material and the use of computer user groups.
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Philip Crompton

Philip is currently employed on the TLTP project Project Varsetile at the University of Stirling, Stirling, FK9 4LA, SCOTLAND, where he concentrates on evaluation issues. Philip is also the prime contact for ELTHE (Evaluation of Learning Technology in Higher Education - self-help group) which holds a e-mail discussion list and a collection of articles relating to evaluation and organises evaluation workshops. The group's world wide web page is at, URL: http://annick.stir.ac.uk/elthe/. To join the group subscribe to ELTHE at mailbase@mailbase.ac.uk.
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Stephen Draper

Steve is based in the Department of Psychology, University of Glasgow, Glasgow G12 8QQ. Steve got his PhD in Artificial Intelligence at Sussex University, and then worked with Don Norman in San Diego, where he began his work on Human Computer Interaction. More lately he developed an additional interest in the application of computers to learning, and led the evaluation group on the TILT project at Glasgow, which developed the method of "Integrative Evaluation".
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Jen Harvey

Jen joined LTDI in 1995, as an Implementation Consultant for the Biological Sciences & Psychology, from her previous post in the Department of Biology at Napier University. Jen obtained her PhD jointly from the University of Glasgow & Napier University, in ways of developing higher level cognitive skills in biology undergraduate students. Jen also worked on three enterprise projects in the areas of student study skills development and group assessment procedures.
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Sue Hewer

Sue works part time at LTDI as an implementation consultant specialising in the areas of modern languages & the metropolitan area networks (MANs). Sue has taught French & Spanish for some 25 years, with and without technology, having been involved in the classroom use, design, development and evaluation of computer-based language learning software since 1981.
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Rupert Loader

Rupert was seconded to LTDI for 1994/95 as Implementation Consultant for Economics and Business. He has since returned to the Department of Agricultural Economics and Management, University of Reading, 4 Earley Gate, Whiteknights Road, Reading, RG6 2AR. Rupert is a lecturer in agricultural economics, specialising in the teaching and research of agricultural and food marketing issues.
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Nora Mogey

Nora joined LTDI in August 1994 as an implementation support consultant in the subject area of mathematics and statistics, and in August 1995 assumed the role of LTDI Development Officer. Nora moved from the Occupational Therapy division at The Queen's College Glasgow, now part of Glasgow Caledonian University. Previously Nora taught maths, computing and outdoor education for six years before studying for an MSc in industrial mathematics at Strathclyde.

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Roger Rist

Roger is the LTDI Project Director and Director of the Learning Technology Centre, Heriot-Watt University, which incorporates the Institute for Computer Based Learning (ICBL). Roger holds a PhD from Nottingham University and a teaching qualification from Moray House College of Education. Having taught for 8 years at a secondary school Roger became a Curriculum Development Officer in Computing Studies for the Advisory Service of Lothian Region's Department of Education in 1990-91, developing and disseminating new materials for the Computing Studies curriculum and organising courses for teachers on the uses of technology in teaching and learning. Roger joined ICBL in April 1991.

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Alan Sangster

At the time of writing his contribution Alan was Reader in the Department of Accountancy, University of Aberdeen. Alan has recently moved to Queen’s University of Belfast as Professor of Accounting. In addition to his accounting interests Alan has long been interested in the use of computers in teaching and is editor of the New Review of Applied Expert Systems (previously The International Journal of Applied Expert Systems)

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Greg Stoner

Greg joined LTDI as Implementation Consultant for Management & Business in 1995 on secondment from Department of Accounting & Finance, University of Glasgow, Glasgow G12 8LE, where he is a lecturer in accounting and information systems. Having studied accounting, finance and operational research at the University of Lancaster Greg qualified as a chartered accountant in 1981, moving to Glasgow after a year lecturing at Southampton University. Greg has been using LT in his teaching since 1983.

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Helen Watt

Helen joined the LTDI team in 1994 as Implementation Consultant specialising in Generic Issues, particularly assessment and evaluation. Helen is on part time secondment from her role within the Staff Development Service, University of Glasgow, Glasgow G12 8QQ. Helen has also contributed to Glasgow University’s institutional TLTP project, TILT, as chair of the dissemination group a member of the steering group and in the evaluation and staff training unit. Helen has worked in computing and teaching for over 20 years and is actively involved in the British Computer Society.

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1996/97

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Development Officer:	Ms Nora Mogey

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Alison Murieson	Art & Design
Jen Harvey:	Assessment Issues

Secretary	Wilma Brown
Technical support	*TBA*

1995/96

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Jen Harvey:	Biological Sciences & Psychology
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Greg Stoner:	Management & Business
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