

3: A conceptual framework for the integration of learning technology

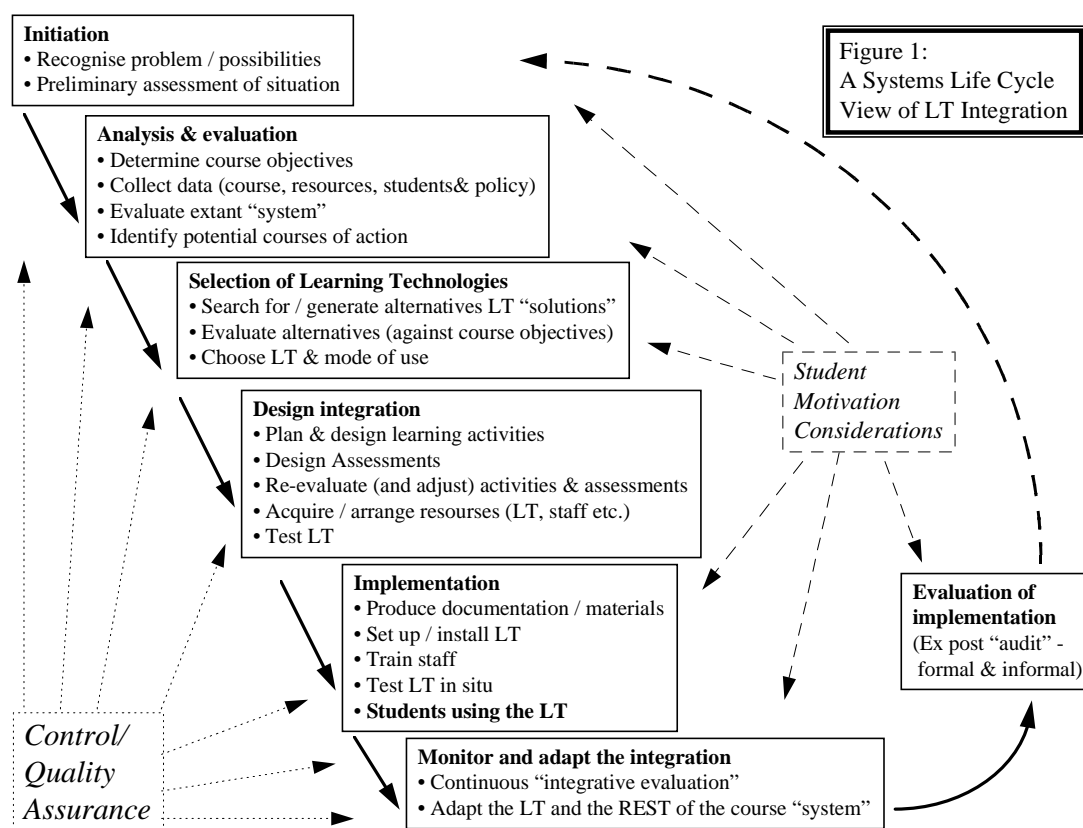
Greg Stoner

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.



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 se* 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 supplantive (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 (suited to 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 rest 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.

References & Further Reading

- Bhaskar, K N and Housden R J W (1990) *Information Technology Management*, 2nd Edition, Heinemann Professional Publishing, in association with CIMA, Oxford.
- Gagné, RM, Briggs, LJ & Wagner, WW (1988) *Principles of Instructional Design*, 3rd Edition, Holt Reinbank Winston, New York.
- Laurillard, D. (1993) *Rethinking University Teaching*, Routledge, London
- Lucas, H C (1994) *Information Systems Concepts for Management*, 5th Edition, McGraw-Hill (Int. Student Edn)
- O'Brien, JA (1994) *Introduction to information systems*, 7th Edition, Irwin (ISBN 0-256-15610-7)
- O'Leary, T.J & Williams, B.K. (1989) *Computers and Information Systems*, 2nd Edition, The Benjamin/Cummings Publishing Co.
- Rowntree, D (1990) *Teaching Through Self Instruction*, Kogan Page, London
- Benton, V, Elder, M & Thornbury, H (1995) 'Early Experiences of MENTORING: Design and Use of Multimedia Material for Teaching OR/MS' Working paper 95/5, Department of Management Science, University of Strathclyde.

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.