Pedagogy, Lifelong Learning and ICT
A Discussion Paper for the Scottish Forum on Lifelong Learning
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In his book "Teachers and Machines" Larry Cuban [1] has traced the history of attempts to use technology in the classroom. Some of the illustrations in that book show, to our modern eyes, wonderfully inappropriate and quaint attempts to use technology in the service of previously conventional assumptions about how to teach. In one example, a photograph entitled "the geography lesson" shows a class of children sitting in orderly rows of pre-war school desks, with a schoolmistress earnestly pointing to something on a geography globe at the front. What makes the photograph hilarious is that the `classroom' is in fact the cabin of an airborne aeroplane, and the photograph appears to illustrate that the technology of flight has simply been used pointlessly to transport a conventional classroom into the air.

The general point, that the effective employment of new technology in education requires a rethink about methods, is one that particularly applies in the context of the radical goals associated with the lifelong learning agenda. The main rationale of this agenda is to draw in to new learning opportunities people who have not previously benefited fully, or at all, from education or training. Also, in the most ambitious way, to reposition education and training so that they will no longer be undertaken at a particular stage of life, providing a single platform of knowledge and skill which will last for a whole career, or for a lifetime. Rather, the term `lifelong learning' has become shorthand for a quite different vision: for a world where re-skilling is continuous, where all kinds of informal learning is accredited, and where people build their own knowledge and skill profiles from an instantly-accessible menu of `bitesized chunks of learning', delivered just-in-time.

No-one assumes that such a profound shift will happen overnight, and some research raises doubts about the goals themselves [2], but there is widespread confidence that the learning revolution has begun [3]. This confidence seems to be at least partly based on an idea that information and communication technology (ICT) is now so pervasive, and so powerful, that major changes in learning simply must follow. The argument appears to be that the power and potential of new technology inevitably means that new methods become available, and thus a new pedagogy develops. Yet, the evidence from the past is clear: new technologies don't inevitably lead to change in education at all. It is arguable that major change in the way in which education is organised - as in the example of the OU - is based not on technologies at all, but rather on pursuing change at the organisational level while carefully maintaining the pedagogical principles which remain fundamental to almost all forms of learning. This still leaves opportunity for big developments in the way education and training are organised: where and when learning occurs, how resources can be accessed, how learning can be assessed, but at the centre there are

some activities which still *must* occur. How are these supported by ICT?

In this brief discussion paper the following questions will be posed:

What assumptions about pedagogy underpin the application of ICT in lifelong learning?

What seem to be the lessons emerging from current experiences in online learning?

What kind of future technology will make a real impact on lifelong learning?

The pedagogic basis for learning technology

As apparently powerful new media have become available to teachers since the 1920s - radio, film, video, multimedia - so we have heard, for sixty years or more, confident predictions of an impending revolution in educational methods. Yet, at least until recently, we could actually feel confident that no new pedagogy was ever going to arrive through a new `*delivery'* technology, however powerful. It was possible to argue [4] that the failure of the technology to produce a real impact on education was due simply to a widespread misunderstanding about learning. This (the `pedagogical heresy') is the pervasive idea that the way in which information is presented to learners is somehow all important.

There are really two pedagogies associated with C&IT. One is the *delivery of information* - this is predominately the pedagogy of the lecture or the book, and emphasises the `IT' - the other is based on the *tutorial dialogue* and involves conversations between tutors and students, and mainly emphasises the `C'. Of course, successful teaching is underpinned by both - and this paper will argue that the rapid interplay of the two is the ideal - but in the context of lifelong learning policy the real problem is that `IT' is cost-effective and the `C' isn't. Unfortunately, in terms of pedagogic effectiveness, the second is better than the first.

The heresy that reappears over and over again is `teaching-by-telling'. The idea - basically mistaken - that it is effective `telling' that holds the key to learning, underpinned much of the rationale for the expensive and largely wasteful courseware development in the TLTP (Teaching and Learning Technology Programme). To take another example, it can be detected in the Government's first response to the Dearing recommendations on the use of ICT, expressing approval for the idea of using technology to capture and distribute `star' lectures. Lectures are important [5] but not because they are ever very effective as teaching by telling, rather because they represent a way of making a direct impact on motivation, and because they are essentially social situations, confirming learners as members of a learning community.

It is possible to detect, over the last 15 years or so, a subtle shift in the language used to describe education and training. Increasingly it is described in terms of `delivery' [6]. Whether this shift of language directly reflects the impressive new capability of ICT to present information in multimedia form is open to debate. Nevertheless, to counter this tendency, let us re-emphasise four fundamental points about learning. Each of these is well understood and empirically sound, but in the language of lifelong learning policy their importance has become obscured by this shift of emphasis.

> *Learning is best viewed as a by-product of understanding, and understanding must be built by the individual learner in the performance of tasks.*

A fundamental description of learning was provided by William James: "*the one who thinks over his*

experiences most, and weaves them into systematic relations with each other will be the one with the best memory". The simple point is that conceptual learning depends on thinking, and the more one thinks about something the better it is remembered. During the 1970s and 80s this point was elaborated into a theory of memory [7] in which it was demonstrated that what is most important is not simply that information is made meaningful, but the richness or degree of elaboration of that meaning by *the learner*. The crucial point is the modelling of learning as a *by-product of comprehension*. This underpins the constructivist approach to education. Learning-by-doing works best because performing a task requires learners to think and comprehend at the most testing level -that associated with problem solving and action.

> *Development of understanding depends on frequent feedback, particularly from teachers and peers.*

Comprehension is rarely an absolute matter, except in fairly closed domains. In general, comprehension will grow as current understanding is applied in different contexts. Thus the adequacy of the understanding needs to be tested, and the results of the test fed back into further conceptual development. The concept of feedback has always played a central role in learning theory. A constructivist approach to learning must provide not only the environment and the tools for the active construction of knowledge, but also the availability of appropriate feedback on the learner's progress.

> *Learning is a progression through stages.*

Another central theme uniting approaches to learning has been the idea that the essential characteristics of the learning process change as learning progresses. It is important to match resources and support to the appropriate stage. Most commonly, three stages have been identified describing the transition from novice to expert performance.

> *All learning is situated in a personal, social and organisational context, which determines motivation.*

Learning is always situated in a context which will shape the approach adopted by the individual. The most important situational variables in education will usually be the nature of the assessment, and the attitudes towards learning of peers. The work or educational context will set the parameters of the learning task, and the most direct expression of this will be the 'contract' between students and teachers/trainers that will set the expectations and norms. Much of what is referred to as student motivation is determined by these factors. The effectiveness of learning technology will, like all other variables in the educational setting, be determined largely by these wider factors, rather than by the intrinsic features of the technology or the content. There is also, as we will see, an even deeper sense of social context - through which the individual derives an identity as a learner.

A Framework for Learning Technology

The following is offered as a framework for mapping kinds of learning onto types of learning technology. (Fuller accounts are given in [8],[9]).

Three stages of learning can be identified: these represent a learning cycle.

· Conceptualisation

- refers to the users' initial contact with *other peoples' concepts.* This involves an interaction between the

learner's pre-existing framework of understanding and a new exposition.

· Construction

- refers to the process of building and combining concepts through their use in the performance of meaningful tasks. Traditionally these have been tasks like laboratory work, writing, preparing presentations etc. The results of such a process are products like essays, notes, handouts, laboratory reports and so on.

· Dialogue

- the testing and tuning of conceptualisations. In education, the goal is testing of understanding, often of abstract concepts. This stage is best characterised in education as *dialogue*. The conceptualisations are tested and further developed during conversation with both tutors and fellow learners, and in the reflection on these.

Figure 1: The (re)conceptualisation or learning cycle

Figure 1 describes a framework which we can use to map learning onto kinds of ICT.

Most learning technology provides access to *courseware,* normally interpreted to mean the computer based delivery of learning materials. The simple term is too general since it obscures differences both in the pedagogy and in the associated technology. Here, a classification is offered, based both on the way the courseware is originated, and on its mapping to types of learning.

Primary Courseware is intended mainly to present subject matter. It would typically be authored by subject matter experts but is usually designed and programmed by courseware specialists. Increasingly, primary courseware will be web-based.

Secondary Courseware describes the environment and set of tools by which the learner performs learning tasks, and the tasks (and task materials) themselves.

Tertiary Courseware is material which has been produced by previous learners, in the course of discussing their learning tasks with peers or tutors. It may consist of outputs from assessment. One kind of tertiary material will be compiled from the questions, answers and discussion that will typically be generated by a computer conference.

Most examples of current courseware are primary. These come in many forms, some of which will involve impressive interactivity in simulated environments. The learner may explore the exposition, and may even be able to pose `what if' questions of the software. Nevertheless, the purpose of the courseware is to provide an exposition of subject matter. Secondary courseware, on the other hand, directly supports the learner's task-based learning activity. One form of this will comprise descriptions, instructions and materials for the learning tasks themselves. The term also refers to the task-support environment. One range of tools, *mindtools* or cognitive tools, have been designed specifically to encourage users to think conceptually about the subject matter being handled. Our concept of secondary courseware would involve any use of the computer to produce output when the task is primarily for learning. By this definition a word processor, or any other productivity software, could be defined as secondary courseware since the defining characteristic is the nature of the task, rather than the attributes of the software. Learning tasks will also require information to be sought, identified and retrieved, and this will mean that information search and retrieval tools will also support the task.

Tertiary courseware is a new conception of courseware, and there are few current examples. The defining characteristic is the 're-use' of the learning experiences of other students. There are many possible approaches, one of which would be to provide a distributed database of answers to `frequently asked questions', where the questions have been collected from real learning episodes. A somewhat different version of the idea emphasises the value of recording discussions between peers, and structuring those into an evolving database.

The idea of tertiary courseware seems important because it offers a way in which computers might be able to provide a partial experience of dialogue in educational situations where it is simply not possible for teachers to engage in one-to-one conversations with students. In that sense it offers a real alternative to intelligent tutoring. The effectiveness of the idea depends on the validity of the concept of *vicarious learning*, that is, the extent to which learners can benefit by being shown examples of the learning experiences of others.

In summary, this framework encourages us to see that each stage of learning should be supported by a different form of ICT. Multimedia and digital broadcasting support conceptualisation, a range of task support software maps onto construction, while dialogue can be conducted through computer mediated communication (CMC), videoconferencing and mobile telephony. Each is important; a fully supportive learning environment requires all three.

What lessons can be drawn from current developments in online learning?

On-line learning is in its infancy, but is developing rapidly on a global scale. We can already see some of its characteristics. Courses are now offered to learners who may live in different countries, but who can experience virtual lectures, synchronous seminars, interactive laboratories, collaborative tasks, chat and asynchronous discussion. The Caledonian-Stirling MSc in Lifelong Learning now has students in Australia and Africa on the same modules as those in the UK. This offers a cultural breadth to the discussion of the subject matter that would be very hard to achieve in conventional campus-based courses. There are unexpected advantages to this mode of teaching. Expert authors can be invited to participate directly in discussions of their own work (always hard to resist). There is now high quality material available on the web which far exceeds in quality what has been developed locally. Yet there are also unexpected problems. Below are quoted some of the conclusions from a recent report on the potential of on-line learning from one of the pioneering institutions in the use of computers in education, the University of Illinois [10]. (There are many such reports now available). The authors looked at both text-based (CMC) and interactive, graphically-based web material. They concluded that the shift from the classroom to online can be described as a shift from `efficiency to quality'. This is quite contrary to some of the assumptions that has motivated funding policy in HE. It is worth quoting directly from the report:

"The scenario of hundreds or thousands of students enrolling in a well developed, essentially instructor-free online course does not appear realistic, and efforts to do so will result in wasted time, effort, and expense. With rare exceptions, the successful online courses we have seen feature low student to faculty ratios. Quality usually doesn't come cheaply: sound online instruction is likely to cost more than traditional instruction. Some students may be willing to pay more for the flexibility and perhaps better instruction of high quality online courses. This appears to be the case for a number of graduate level business-related schools. However, it is likely that a high number of `traditional' students, will continue to want to pay for a directly attentive professor and the on-campus social experience.

High quality online teaching is not just a matter of transferring class notes or a videotaped lecture to the internet; new paradigms of content delivery are needed. Particular features to look for in new courses are the strength of professor-student and student-student interactions, the depth at which students engage in the material, and the professor's and students' access to technical support. Evidence of academic maturity, such as critical thinking and synthesis of different areas of knowledge should be present in more extensive online programs."

ICT has made possible important aspects of the content and management of education which were previously quite unachievable. Yet the evidence is now accumulating that nothing has really changed at the pedagogic level. For every lifelong learner we must ask the question first "who is going to be your tutor, and how much feedback will you get?" Only when that question is clearly answered should we ask how the tutoring will be done and how the learner will be supported with learning materials.

What kind of technology will make a real impact on lifelong learning?

Our framework allows us to see how and where technology can impact on the learning process. We have previously used this to emphasise the importance of dialogue, and the potential in learning for communications technology. The concept of tertiary courseware involves converting communication into information. In fact almost all tutorials involve an interplay between information and communication. It is hard to think of any teaching events which don't.

In discussions about future ICT the term *`convergence'* is usually employed to describe the coming together of digital broadcasting and web technologies. We might usefully generalise the term here to describe the integration of information and communication. In a learning context, we might envisage a conversation in which reference to concepts, objects or people can be supported instantly by illustrative or explanatory material, where questions can instantly be matched with answers, or where we might choose to see where similar conversations have led in the past. All this can be achieved with existing technology made more powerful through speed of operation, and perhaps with some advance in speech recognition. Whether such information-rich dialogues will be achieved through web-enabled digital television, or through the next generation of mobile telephony, or through the convergence of both, is not clear. Table 1 indicates the remarkable advance in telephony which will soon see telephone access for data at a rate of about two millions bits per second, at which a picture down-load time is reduced to about 0.4 sec. However, for such an integration of information and communication to be truly *pedagogically* powerful will depend not so much on the technological capabilities as on the development of genuinely usable interfaces, and on the way in which such technology will be employed in real education and training settings.

Table 1: The downloading of a picture through telephony

Item	Data Rate (bits/sec)	Transmission Time for one still picture
Marconi in 1901	1	9 days
Modern Optical Fibre	40,000,000,000	0.00002 sec
Copper Wire to home	30,000	26 sec
Today's mobile phone	9,600	1.4 min
Future copper and mobile	2,000,000	0.04 sec

Mobiles under development	150,000,000	Less than 0.01 sec

So can we discard our reservations about whether revolutionary pedagogical advances will come through technology? Very soon, we can assume, learning technology will powerfully augment real learning dialogues through information, and information will be powerfully augmented through communication. Primary, secondary and tertiary courseware will become seamlessly integrated. This will be possible for students anywhere who have access to the technology, at any time. One can argue perhaps about the timescale involved, but these predictions are not dependent on major breakthroughs in artificial intelligence, almost all of this is achievable with incremental improvements in existing technology.

Nevertheless, no mere improvements in the support of an individual's learning, however powerful, will succeed in achieving the goals of lifelong learning. For this to happen we need to move the focus of support to groups.

Techology and the Social Dimensions of Learning

Let us return to our four key points about learning. By emphasising the support of dialogue, and by offering a seamless integration of information with communication, technology might effectively support the first three points. Of course, there are still big questions about whether the required level of feedback will be achievable without enough teachers to go round. This is why the effectiveness of tertiary courseware seems so crucial, and why it is necessary to build in collaborative learning tasks to maximise peer dialogue. And it is not just discussion per se that is important - there are a growing number of studies which suggest that without a task structure which encourages or requires dialogue many learners will simply choose not to engage in discussion. Nevertheless, by characterising learning as task-based, and dependent on feedback, we provide a guiding rationale for technology. This is not really the case for the fourth point - the social basis of motivation - and this is where there is most scope for impact.

The term, lifelong learning, must - if it is to mean anything - convey the importance of an attitude to learning. Attitudes are rooted in the social and cultural environment, and are not normally analysed at any level on which technology will seem relevant. Yet communication is central to the maintenance of human relationships, and the technology to support communication can make a difference to how effectively relationships can be formed and nurtured. Education can be modelled as a network of relationships, and the individual learner can be viewed as a single node in a complex network. It is likely that greater insight into pedagogic innovation is to be gained through focusing on the social dimension of communities of learners than on continuing to view the learner's key relationship as being with the subject matter, or at best with a tutor. Universities, for example, are loose structures for binding together a large number of identifiable learning communities, each of which is itself a complex, overlapping and constantly changing set of relationships. The way in which individual learners identify with particular communities will determines most of how they think and feel about learning. Some current work funded by a consortium of European telecoms companies is seeking to design applications and interfaces which aim directly to support learning relationships. This, I believe strongly, is exactly where we should now be looking.

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