Information literacy evaluation: moving towards virtual learning environments

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Abstract

Evaluates the evidence for and against the effectiveness of electronically delivered information literacy programmes in comparison with personal contact teaching. Shows that computer-aided learning approaches to user education have great strengths but also undeniable weaknesses. The way to promote higher levels of information literacy in the electronic library environment is to increase the levels of computer-led delivery, as long as this is done in such a way as to maximise the strengths of the format. This is best done in the context of an integrated virtual learning environment (VLE). Such an environment would promote information literacy synergistically as one of a suite of multiple electronic literacies that can be learnt alongside each other. Exploiting a VLE in this way would also facilitate the integration of information literacy into the broader curriculum. Computer-based user education to date could be viewed as having been constrained by a need to imitate well-established, tutor-delivered user education methods. Without an ambitious programme of integration into larger scale e-learning models, this pattern of constraint will continue.

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Introduction

Nowadays there are great claims made for computer-aided learning (CAL) packages in higher education. Tapscott (1998), asserts that "CAI (computer aided instruction) programs can improve learning performance by one third", quoting Schutte (1996) as proof. (In fact Schutte is sceptical about how technology improved learning, "I suspect as much of the performance differences can be attributed to student collaboration as to the technology itself.") As a result, similar claims are made for such packages in information skills and information literacy teaching. Tapscott's optimism about CAI improving learning outcomes has led one librarian to deduce that "CAI [is] advantageous for user education programs" (Germain *et al.*, 2000). The advent of virtual learning environments (VLEs) as vehicles for user education delivery has further intensified this interest in the superior claims of computer-mediated user education (Currier *et al.*, 2001). Are these claims justified, or are they merely examples of the hyperbole that surrounds much modern information and communications technology?

This paper looks at documented user education practice using CAI. Having derived certain lessons from this, we examine new data gathered from our own experience of user education practice. We use these data to ascertain the genuine benefits of electronically delivered user education, and then attempt to draw conclusions about how best to use e-learning methods in the promotion of information literacy.

Literature review

A variety of authors have surveyed the literature of educational technology in information skills teaching (including Cox, 1997; Rader, 2000; Contini and Kaplowitz, 2000; Joint *et al.*, 2001a). Broadly speaking, terms such as CAI, CAL or courseware are used interchangeably to refer to most computer-based approaches to user

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education, and this paper will use these terms in a similar fashion. The literature also reveals the importance of distinguishing the teaching of "information skills" (training in mechanical competencies) from the concept of "information literacy" (implying the intelligent use of such mechanical skills for academic purposes), though in practice this distinction can become blurred, with the concept of "user education" sitting somewhere between the two. This paper will try to respect this distinction. Above all, these reviews show gaps in our understanding of the subject.

First, clarity of thought about the benefits of courseware approaches in user education is sometimes lacking. An admirable enthusiasm for the medium eclipses critical objectivity about the enterprise in which the teacher librarians are engaged. Second, comparative evaluations are rarely undertaken, with the result that the case history literature of CAI or CAL in information skills teaching frequently repeats the conclusion "CAL is an effective way of delivering user education ...". Of rather more interest are papers saying "CAL is a more (or less) effective way of delivering user education in comparison with what we have done before". Such papers are not numerous. In response to this, our paper will attempt to assess the relative merits of CAL and traditional, tutor-led methods in user education with a view to showing the way forward for CAI methods in the electronic library.

Defining the goals of computer-based teaching

Existing definitions and methodologies

To assess the worth of computer-based information skills teaching one must define its goals accurately (Draper, 1996). These can be construed as those generally associated with all CAL. Salisbury (1971) defines the educational interaction of computer-administered instruction as:

> ... a man-machine interaction in which the teaching function is accomplished by a computer system without intervention by a human instructor. Both training material and instructional logic are stored in computer memory.

Librarians use this definition in their own practice. For example, Michel (2001) praises this as "the authoritative definition for CAL today", and applies it in her own Web-based library skills work. However, if misinterpreted such a definition can present a number of problems for the practitioner librarian. Above all the definition may be taken to imply that CAL can achieve learning outcomes without human agency. This in turn leads to a false goal being set for library CAL. The goal is "to do teaching without human mediation", an achievement which, it then follows, must be intrinsically worthwhile educationally. At its worst this may lead to the assumption that the creation and use of a CAL package in any form at all gains the advantages of teaching without human agency. However, it is quite logical to argue that "teaching without human agency" is not the goal of CAL, in either information skills teaching or in the more ambitious goal of promoting information literacy.

The general characteristics of CAL methods of user education

The most significant characteristic of the CAL approach in user education is not that it does away with human agency in the teaching process. Given that all the material in any courseware package is generated by human knowledge and intelligence, CAL is impossible without human involvement in every aspect of the teaching and learning process. Rather, CAL is an asynchronous teaching method, whereby the various stages of the teaching and learning process are to a greater degree separated in time into a discrete sequence of events than in other, synchronous teaching methods. The main separation in asynchronous teaching and learning tends to be the separation of teaching activity from learning activity, with no direct face-to-face contact between tutor and student. This is as true of an old-fashioned correspondence course as it is of most CAL-based user education practice other than the minority of cases where computer-mediated communication (CMC) methods such as e-mail or video-conferencing are used.

Redefining CAL-based user education practice as simply another form of asynchronous teaching method has two advantages. It strips the medium of the quasi-miraculous qualities often attributed to any IT-based approach and reveals that the CAL approach, rather than removing the human element in teaching, simply adapts it in order to separate the human contact point between teacher and learner. It also reminds us that all

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asynchronous methods share many of the same strengths and weaknesses, regardless of whether they are IT-based or not.

Shared advantages of IT-based and non-IT-based asynchronous user education

User education practitioners are aware of the value of asynchronous teaching methods and have in the past used a variety of non-IT-based asynchronous methods such as distributed workbooks. These methods have many of the educational benefits of CAL packages (Madland and Smith, 1988). The characteristic advantages of CAL cited in the user education literature are in fact largely those of non-computer-based asynchronous teaching and learning methods.

For example, both workbooks and CAL packages can be used any time, any place, anywhere – thus allowing learning to take place at greatest time of need, rather than when the timetable permits. Some students learn better in class, some learn better in independent study and any asynchronous method will be better suited to the latter students' learning style. Workbooks, correspondence courses and CAL packages better suit the distance learner or part-time student. Such approaches also place the onus on the student to draw fully on their own abilities rather than relying on the teaching and support of an omnipresent tutor. And quite simply, asynchronous methods can be very cheap – it is cheaper to send additional copies of a correspondence course to an intake of new students than arrange expensive personal contact teaching time for them in seminar groups.

The fact that CAL is just another asynchronous teaching method gives us ground for caution therefore. Asynchronous teaching methods have never been widely used, at least in UK user education practice. The assumption is that teaching without tutor-contact leads to an unacceptable lowering of the quality of teaching and learning, the main gain being cost savings. Unless UK user education practitioners have collectively been ignoring a teaching approach of high importance this implies that the argument for CAL-based user education has been overstated, CAL being no more than old wine in new wineskins.

Any investigation of the merits of pure courseware-based user education should therefore investigate two things in particular. First, although CAL may be inherently very similar to traditional asynchronous approaches to teaching, it may deliver the benefits of asynchronous teaching more intensively than traditional asynchronous methods. That is, rather than doing something inherently new, it may do the same things better, thus bridging the perceived gap with tutor-contact learning outcomes. And second, CAL may deliver such high quality learning outcomes with significant economies that are quite beyond tutor-delivered teaching methods.

Designing a case study

In examining these two aspects, our reading of the literature reminded us of the problems we would need to consider before designing our own case study.

Case study costings

A significant number of case studies told us that the costs of creating packages with the potential for sophisticated automated feedback were too great for the packages ever to be updated economically. For example, the highly effective TILT information skills CAL packages at Glasgow University (Creanor *et al.*, 1996) have remained largely unmodified and become increasingly less used. This shows that some of the specific advantages of CAL packages mounted on central servers – their potential for instant updateability and their cheapness of distribution via the network – can be contradictory. The economic benefits of spinning out a package to an indefinitely large potential number of students can be negated by the costs of re-designing and updating a sophisticated package.

Non-comparative "hybrid" case studies

Second, the aim of most investigations of CAL was not comparative. Using very much a hybrid approach to teaching, they simply aimed to enrich the texture of teaching by using CAL packages as another golf club in the mixed bag available to user education tutors. In these case studies, librarians were very heavily involved as traditional teachers interacting immediately with students in their use of packages, attending computer workshops, giving preliminary advice, and enhancing the feedback given by the packages. This rich and effective hybrid teaching approach is actually very expensive,

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and clouds any awareness of the true costs of CAL-based user education approaches. The hybrid approach also makes comparisons between methods very difficult, since it is impossible to pick apart which specific teaching method generates which particular learning outcome.

True comparative evaluation case studies

The common use of hybrid teaching methods that mix human and computer-mediated approaches is a curiosity of the literature of CAL in libraries. If the underlying goal of such case studies is to pursue the advantages of "teaching ... without intervention by a human instructor" (Salisbury, 1971), then purity of method is important. Put simply, librarians should not be present at workshops, augmenting the educational impact of their courseware with "human intervention". Open University tutors do not deliver their learning materials by hand in order to eavesdrop on their use in the student home, and CAL materials should be no different.

Thus, any evaluations of improved learning outcomes from such hybrid workshops do not prove that "CAL works", since any educational benefits of such workshops may be entirely due to the human interventions that accompanied the use of the CAL packages. The use of an asynchronous definition of the CAL method (rather than one that emphasises the use of a remarkable technology *per se*) underlines how vital it is to keep separate the elements of the teaching process, regardless of the IT component. In a pure CAL workshop, tutor contact time must be minimal or better non-existent, otherwise the workshop may be no more than a traditional teaching session with a bit of IT support.

An examination of the few comparative case studies where teaching methods were kept apart and evaluated separately showed that the success of the pure CAL approach was variable. The best comparative case studies do not in fact give a clear indication that CAL methods work better than traditional methods.

Thus, in Lawson's (1989) case study, the CAL approach gave better learning outcomes than the traditional, tutor-mediated approach. However, learning goals were elementary – the CAL package offered a "library tour". Similarly, in Nipp and Straub (1986), the CAL approach emerged the better, but was simply trying to offer basic "library orientation". By contrast, Madland and Smith's (1988) study looked at different levels of learning attainment and found that CAL was better for mechanical information skills teaching, but worse for encouraging conceptual thinking. Kaplowitz and Contini (1998) and Vander Meer and Galen (1996) attempted simple forms of information skills instruction, but discerned no significant difference in benefits from either computer-based or traditional methods.

These are complex findings. It seemed that the CAL approach failed to teach sophisticated information skills better than the traditional method, though it might succeed with basic library orientation, mechanical information skills teaching and other simple information retrieval techniques. Whether it was broadly more successful than traditional methods was not clearly demonstrated. There was certainly no convincing evidence that, *pace* Tapscott (1998), CAL-based teaching broadly improved learning outcomes by one-third.

Conclusions for designing a case study

We concluded that the case for educational technology in information skills teaching was indeterminate. There was some evidence that simple information skills could be taught successfully by such methods. This may have been because many case studies look at CAL packages that used mechanical drill-based exercises – such techniques suit a simplistic information skills syllabus that is easily assessed by such online multiple-choice methods. If we were to achieve more sophisticated learning outcomes in information skills or even information literacy, a different approach would be advisable. More modern multimedia approaches using Flash or VRML software offered an alternative but again may lead to superficial teaching outcomes, given the unsuitability of text-based database searching skills to such a teaching style. We could entertain the student with such technologies but we felt that they were not suitable for complex learning outcomes in which information literacy rather than information skills were to be taught.

This meant we might be best advised to adopt a technically simple but intellectually rich hypertextual approach. Our learning goals would not then be constrained by the

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limitations of drill-based multiple-choice-style exercises, nor would essentially superficial content be concealed beneath a veneer of multimedia effects. This would also make the package economical to author, and economic to update.

We also concluded that our case study evaluation groups must be set up differently. Our study would keep the teacher-delivered and CAL-mediated methods apart to examine their relative learning outcomes quite separately; and it would try to examine the genuine economic benefits of CAL methods while measuring the effect of such economies against any loss of effective learning outcomes. That is, it would be important to use a CAL package with an absolute minimum of professional librarian time involved in transmitting and supporting learning materials, so that we maximised the economies in teaching delivery. This would complement the economies gained by adopting a simple hypertextual approach to authoring the package. In contrast to the simple technical platform, we would aim for a sophisticated not simple level of information skills – that is, we would aim our teaching at honours (third and fourth year) undergraduates and postgraduates who were attempting fairly ambitious information retrieval goals.

Description of our case study

Approach

The Andersonian Library at the University of Strathclyde had inherited a set of user education materials from the cross-institutional Glasgow Allied Electronically with Strathclyde (GAELS) project that were intended for postgraduate engineering students (GAELS, 1999-2001). These used the design specification sketched out above (Joint *et al.*, 2000): a simple hypertextual authoring approach aimed at a higher level of information skills training than simple library orientation. The courseware evaluations of the latter phase of the project had originally been designed to demonstrate that these cross-institutionally authored packages achieved a reasonable level of success in a straightforward, tutor-led workshop environment (which was the basic requirement of the original project). As the project neared completion, we decided to adapt these materials to other subjects and use them across a wide variety of subjects other than engineering (GAELS, 2000-2001). We also decided to do more than demonstrate that the project learning materials were effective *per se*. To illuminate the comparative issues outlined above we would enrich the evaluation methodology and perform a comparative evaluation of different user education methods, of which the GAELS packages would be one example.

We decided to perform the evaluations in the following way:

(1) We would use the GAELS materials in hybrid workshop environments where librarian tutors backed up the online materials with personally mediated support. This is typical of the US hybrid approach, of which the overview by Getty *et al.* (2000) provides various representative examples that mix traditional methods with CAL-based materials.
(2) We would also use them in an environment where no expert help was available. This amounted to two broadly similar contexts. First, in workshops led by IT-competent non-librarians who were broadly ignorant of the teaching materials in the packages, but who were capable of dealing with purely technical problems that cropped up in the workshops. Lederer (2000) is an example of a similar approach, using graduate teaching assistants rather than librarians to support a CAL package. Second, we would ask students to complete a package entirely on their own, without any support, and see what the learning outcomes were from such independent study.
(3) We would also evaluate our existing traditional user education programme, and compare the learning outcomes from these with learning outcomes from the hybrid and pure CAL groups.

In order to ascertain the effectiveness of all three approaches, we would distribute identical questionnaires that prompted students to evaluate how their information skills had improved as a result of taking training in one of the three formats outlined above (see Appendix). We would have preferred the questionnaire used to have been derived from a robust "confidence log" model that we had used in the earlier part of the GAELS project (Kemp, 1999). However, we

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were interested in the possibility of integrating our teaching into the larger scale framework of the IT skills programmes run at the Universities of Strathclyde and Glasgow. We decided to import the simpler five-point Likert scale questionnaire that the Strathclyde IT skills programme used. With this questionnaire we could still attempt to measure other factors that might affect the quality of learning outcomes, such as high or low initial knowledge, the quality of the presentation of learning materials, and the difficulty of the tasks set as part of the package or class. The results from these simple questionnaires would allow some direct form of comparison between the three clearly separated forms of teaching offered to the different groups. (Note that an earlier account and data analysis of the project's findings, satisfying the original more limited requirements of the project brief, is available (Joint *et al.*, 2001b).

Problems

As with so many attractive experimental models, this approach did run into problems. The Andersonian Library has a well-established traditional user education programme, and it was fairly easy to convert significant numbers of our traditional user education workshops into hybrid courseware-based workshops run by professional librarians. However, it was far more difficult to create a controlled environment in which students would take the courseware package without the ritualised teaching environment of an on campus workshop attended by tutor librarians. This meant that the numerical distribution of students between comparison groups was very uneven.

In the end, 76 honours science faculty students took the package in workshops attended only by departmental technical support staff. This group was denied access to knowledgeable information professionals. The technical support staff at these sessions ran the workshop, but only offered IT support in case of PC or network glitches. This group therefore gave us very pure data that could be compared with different data from the two other groups: a group taught in hybrid workshops consisting of 185 science faculty honours students, and a traditionally taught group of 176 honours science faculty students. We also obtained feedback data from traditionally taught honours and postgraduate students in other faculties: 92 arts and social science students, 410 business students and 248 engineering students, all of whom were taught in librarian-led user education classes.

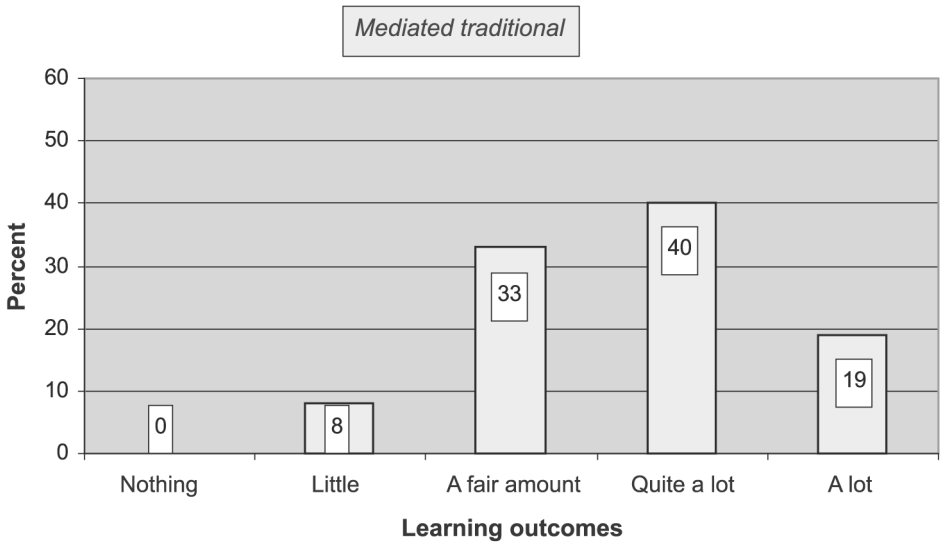
Reported learning outcomes

The most important indicator we wished to track was the level of learning outcomes reported in questionnaire returns. On a five-point Likert scale, we were looking at the distribution of returns from students, starting from a peak of 5 (indicating that the student had learnt a lot), then 4 (quite a lot), 3 (a fair amount), 2 (indicating little had been learnt) or 1 (nothing had been learnt). As the GAELS project final report showed there seemed to be little difference in the levels of learning outcomes reported by traditionally taught students across all four faculties. On average around 90 per cent of all students taught by traditional means reported "high" learning outcomes in each faculty, as opposed to "low".

However, this simple breakdown of the five-point Likert scale into two opposing results (reported learning outcomes in the high region 3, 4 and 5, versus reported low outcomes on points 1 and 2 in the scale) struck us as an inappropriate use of the five-point scale. So, for this paper we decided to re-interpret the reported learning outcomes of the subdivided groups in the science faculty and look for general patterns over the entire five-point scale. When analysed in this way, as reliance on educational technology increased we saw a decline in the level of reported learning outcomes across the three sub-groups. Thus, the most favourable student feedback about learning outcomes was in the traditionally taught group (Figure 1). Here the largest proportion (40 per cent) reported learning outcomes at point 4 on the scale ("I learned quite a lot") and nearly one-fifth reported learning "a lot".

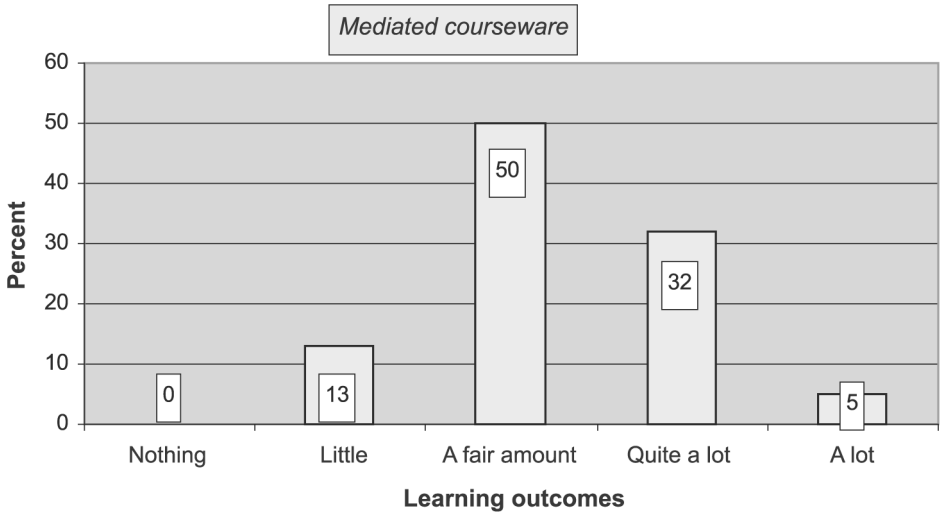
In contrast to Figure 1, in the hybrid sub-group where students were taught by courseware with librarian-tutors in attendance, the highest level of returns (50 per cent) was lower, at point 3 (Figure 2). So most claimed to have learned "a fair amount" (point 3), whereas most in the traditional sub-group had made the more impressive claim of having learned "quite a lot" (point 4). The traditionally taught group had nearly four times as many students claiming to have learned "a lot" when

Figure 1 Traditional sub-group. Reported learning outcomes from honours science faculty students taught by traditional, tutor-librarian mediated methods. Base = 176. No response from nine (5 per cent) in this sub-group



Note: Base = 176. No response from 9 (5%) in this sub-group

Figure 2 Hybrid sub-group. Reported learning outcomes from honours science faculty students taught in CAL workshops but with tutor-librarians in attendance. Base = 185. No response from two (1 per cent) of this sub-group



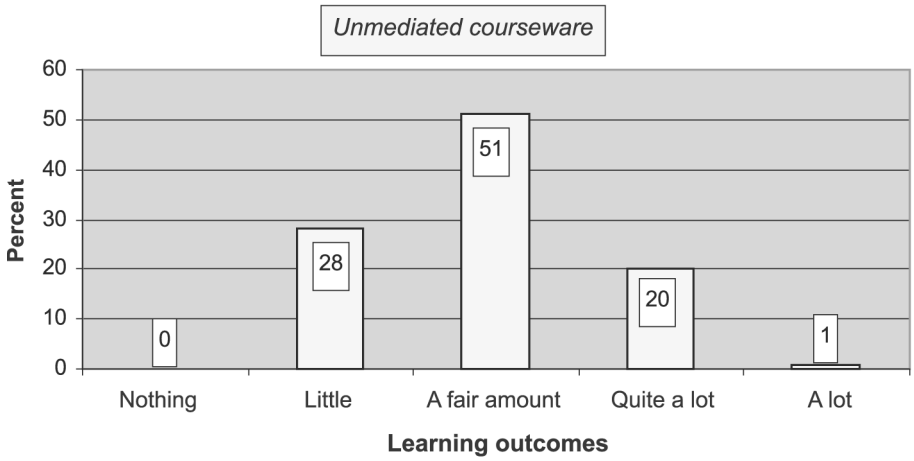
Note: Base = 185. No response from 2 (1%) in this sub-group

compared with the hybrid group. And where only 8 per cent in the traditional sub-group learnt "a little", 13 per cent in the hybrid sub-group made this claim.

The starkest contrast is revealed when looking at the courseware-only sub-group (Figure 3). As with the hybrid sub-group, around half this sub-group claimed that they had learned "a fair amount". The level of negative responses is much higher in the courseware-only sub-group, with 28 per cent reporting that they learned only a little, as opposed to 13 per cent in the hybrid sub-group and 8 per cent in the traditional sub-group. Virtually none of the courseware-only group reported having learned "a lot", unlike the other two sub-groups.

In summary, this re-interpretation of the data in the original GAELS report over the full five-point scale shows that there is a gradual falling away in reported levels of learning attainment, the greater the reliance on educational technology. Although the best hybrid outcomes surpass the courseware-only best outcomes, they also represent a lower level of success than the traditional outcomes.

Figure 3 Courseware-only sub-group. Reported learning outcomes from honours science faculty students taught in CAL workshops with no tutor-librarians present. Base = 76. All students responded in this sub-group



Note: Base = 76. All students responded in this sub-group

There could have been a number of reasons for these differences in reported learning outcomes across the three sub-groups, and the questionnaires did attempt to elicit feedback about these factors. However, examination of these factors did not produce a significant relationship. That is, the pure CAL sub-group did not report that their initial knowledge was significantly lower or higher than the other sub-groups, they did not describe the quality of their workshop to be significantly worse or better than the other sub-groups, and they did not find the tasks assigned to them to be any more difficult or easy than the other sub-groups. The main differentiating factor seemed to be in the teaching method.

So, in contrast to Tapscott's (1998) assertion that "CAL programs can improve learning performance by one third" (which may be generally true), our data seemed to suggest something else. Our attempt at fairly sophisticated CAL-based user education outcomes with negligible tutor contact supported Madland and Smith's (1988) findings. To quote just one indicator from our study, the number of CAL-taught students who claimed to learn "quite a lot" was 50 per cent lower in comparison with traditional tutor-led methods.

Commentary

Numeric distribution between groups

There are a number of aspects of our study that we acknowledge as being less satisfactory than we would have initially hoped. The numeric distribution of students between groups was clearly very skewed. One of the incidental intentions of the study was to give us some idea of the overall quality of the entirety of our user education programme, which accounts for the distribution of the questionnaire to all traditionally taught students.

If the superabundance of data from traditional students is set aside, we did attempt to create three core science faculty groups which were similar in size. We targeted an equal number of students in each category, but with the CAL-only group, the numeric return from students who were asked to complete a package outside of a workshop, that is, entirely on their own and without any help, was negligible. This was in spite of good support from supervisors who encouraged the students to complete the package. This reduced our pure "courseware-only" returns by a factor of some 30 students. In the end, we had to discount this subset of the CAL group entirely. By contrast, attendance at all the workshops was good, and the return of questionnaires to workshop leaders virtually complete.

Questionnaire methodology

Our questionnaire methodology was less sophisticated than the more robust confidence-log techniques that we had used in smaller scale pilot phases of our investigations (Kemp, 1999), as noted above. This intensified our feelings that the method was overly reliant on subjective feedback from

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students about how much they felt they had learnt rather than objective assessment. However, since we wished to avoid mechanical drill-based exercises in the package, objective assessment via exercises within the package was always going to be difficult for us. We had received strong user feedback previously in the GAELS courseware project that research students in technological sciences felt that multiple-choice-style tasks were unsuitable for the type of information usage that they were engaged in. Moreover, from the students' point of view, this was a formative assessment exercise to improve self-awareness of levels of information literacy.

However, some objective assessment (for example, just from a sample of our students) carried out as a separate exercise using pre- and post-testing would have clarified this issue. Such objective assessments will be introduced into our user education work in the coming session 2002-2003, and the results used in comparison with our existing data.

Interpretation of results

In spite of the reservations above, we believe certain clear themes emerge from our investigations.

Issues of resourcing

First, it appears that information skills courseware is a representative form of asynchronous teaching approach, which does achieve good learning outcomes in a fashion typical of other asynchronous approaches. It thus has the disadvantages of asynchronous approaches together with some unique advantages. In particular, IT-based asynchronous teaching approaches (CAL) can be very costly due to initial costs of creation and ongoing costs of maintenance.

Second, when used in a very pure form, with a minimum of mediated support, CAL packages achieve good learning outcomes in a majority of cases (51 per cent of students said that they learned "a fair amount" from our courseware and 20 per cent learned "quite a lot"). This success level may be lower than that of traditional approaches (where an extra 20 per cent of students learned "quite a lot" and beyond that 19 per cent learned "a lot"), but it is still very impressive. If CAL packages can be delivered more economically than traditional teaching, then this fall in educational effectiveness may represent an acceptable trade-off against cost.

Third, when using a CAL approach user education programme, it is vital to gain the maximum level of advantages from the format, to compensate for the disadvantages. Courseware packages can be delivered very cheaply, with no professional librarian mediation at point of delivery. This advantage can offset the costs involved in creating and maintaining them as long as the packages are not too difficult to update. This advantage will increase the larger the number of students who exploit the package. This benefit disappears entirely if information skills packages are used in small hybrid group workshops with professional librarians heavily involved in supporting them. This is not to deny the effectiveness of such hybrid approaches, but from an economic point of view they are adding the costs of traditional teaching delivery to the costs of courseware development and maintenance. Not only are such hybrid approaches more expensive than traditional or pure CAL approaches, according to our investigations they are less effective than traditional methods.

Information literacy and IT literacy

Thus, an effective way of implementing a courseware-based user education package would be to use it in a very large-scale teaching programme where the teaching delivery is done by non-professional staff – good graduate teaching assistants or technical staff would be an appropriate choice of tutor for such courses. Centrally managed, institution-wide information technology training courses are widely offered in the UK nowadays, and, according to the CITSCAPES project survey of such courses (Reibig, 2001), 60 per cent of a representative sample of such courses already include some material on the use of online library catalogue searching, and 47 per cent also include bibliographic database searching. Moreover, there is a growing belief in the possibility of an effective convergence between the teaching of IT literacy and information literacy, which makes integration of user education material into such courses entirely logical (Martin and Rader, 2002).

However, if a user education package is spun out to an entire student body via such a programme, evaluation of learning outcomes must take place, because a significant number

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of students will not achieve adequate learning outcomes. Our investigations above show that, regardless of method, a variable but still significant number of students can learn only "a little" from information skills training. Fortunately, systematic assessment of learning outcomes is an intrinsic part of such IT training courses (in contrast to most library-led user education programmes). By integrating assessment of information literacy levels into the assessment component of such IT training programmes, all students who are identified as lacking sufficiently improved information literacy learning outcomes could then be offered remedial teaching support by dedicated professional librarians using traditional methods. Integration of information literacy with IT literacy programmes would not therefore sideline the traditional teaching role of user education librarians. Rather it would help maximise the effectiveness of such teaching by concentrating it where it is most needed.

This large-scale, integrated model offers a significant resource saving while achieving the "holy grail" of user education – user education as a core skill required for all, backed by an institutionally validated system of accreditation with the possibility of a minimum standard to be achieved by all. This model also offers libraries significant resource savings, concentrating precious professional librarian staff time on dealing with students who cannot learn without personal attention. Far better to concentrate resources in this way than to try and extend personally mediated small group workshops run by individual librarians to an entire student body.

Information literacy and virtual learning

This paper has tried to use the term "information skills" in a different sense from the concept of "information literacy". This is because the higher learning aims of "information literacy" – that is the intelligent application of mechanistic information retrieval techniques to a student's mainstream learning tasks – are very difficult to achieve either in self-contained information skills courseware packages, or in isolated, library-run user education classes, or even in large scale IT literacy programmes.

As stated above, one great potential benefit of courseware material is the ability to insert it into the learning environments of mainstream teaching departments. Properly managed, such organic integration of virtual learning materials offers students the ability to learn information skills in context rather than out of context. They can therefore immediately apply what they have learned to the real learning tasks of their degree discipline, thus achieving a higher degree of information literacy, rather than mechanical skills.

Thus, technophile librarians should not be too disappointed if traditional, librarian-led classes emerge as a more effective if resource-hungry teaching method. Online user education materials may still have a significant advantage if they are well integrated into mainstream virtual teaching materials – such integrated materials might be more effective at teaching information literacy rather than information skills. This is an educational achievement of greater significance. However, our case study did not investigate curriculum-integrated information literacy packages, and there is a need for proper evaluative studies of this claim.

Unfortunately, much recent interest in VLEs among librarians seems to be mainly in the courseware authoring tools that they offer. VLE tools are often used by tutor-librarians simply for creating free-standing information skills packages, rather than as a means for bringing together library materials and course materials over a common technical platform. If "an online learning environment is a convenient way of accessing a range of materials connected with a course of study" (MacColl, 2001), this also implies a common space for the integration of information skills material and curriculum material. And there are now some good examples of such learning environments, especially in the USA. For example the TWIST initiative (University of Iowa, 2001), using the "instruction commons" at the University of Iowa provides just such a common ground, in which information resources and information literacy materials co-exist with the courses they support.

Total integration

In summary, in order to maximise the benefits of CAL approaches to user education, and to offset its disadvantages in comparison with traditional user education methods, we would advocate progress on these two fronts simultaneously. First, we support the integration of online information skills

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material into the mainstream curriculum via VLEs, but in the widest possible sense of "an information and learning commons". This enhances the student's pursuit of information literacy rather than the de-contextualised acquisition of mechanical information skills.

Second, any such integration risks the problem of low learning outcomes for student learners who report that unmediated electronic learning is less effective for them than tutor-led teaching. Parallel with integration into the curriculum, there should be a process of information literacy assessment and remedial education within large-scale mixed medium "electronic literacy" programmes that include an information skills or information literacy component.

Although such programmes would teach the core skills of information literacy outside of the mainstream curriculum, they would target students for direct tutor-librarian contact more effectively. User education material integrated solely with the curriculum would not be so amenable to such assessment. It is also likely that the teaching of information literacy in such programmes could also benefit from the synergies with the other electronic literacies. These synergies would compensate for the absence of the prime synergy that turns information skills into information literacy, the synergy with the curriculum context.

It is this picture of managed integration across two fronts that will, in the end, realise the true mutual benefits of virtual learning and information literacy teaching. On the one hand it takes full account of the drawbacks of promoting information literacy via IT-based methods, but uses IT-based solutions (VLEs in the largest possible sense) and non-library-based teaching innovations (electronic literacy programmes) to offset these drawbacks. Efficient management of resources is also integrated into this model – above all, the economies of scale. Ultimately, the way forward for IT-based methods of promoting information literacy is to acknowledge that they do have shortcomings. However, we believe these shortcomings are the result of inappropriate and small-scale implementations of such learning technology. Now is the time to implement this technology on a more wide-ranging and ambitious basis than ever before in order to take full advantage of the strengths of the medium.

Conclusions

This paper describes an attempt to evaluate the relative merits of user education conducted in two different ways: by traditional personal contact teaching as opposed to CAL or courseware-based user education. A number of different factors were used as evaluative criteria. In particular, economic benefits were included as well as the quality of learning outcomes. A distinction was also made between mechanical information skills teaching and the higher learning goals of information literacy, that is, the intelligent application of information skills to mainstream curriculum learning.

In the course of this study we made a number of observations:

- Whereas simple or mechanical information skills teaching may be delivered to comparable effect via CAL methods or tutor-led methods, more ambitious information literacy learning goals may be more difficult to achieve by CAL in comparison to tutor-led methods.
- Our own case study showed that higher-level information literacy learning goals were achievable with CAL approaches, but the level of achievement was not as high as with tutor-led methods.
- A significant minority of students fail to achieve acceptable levels of information literacy skills as a result of user education programmes, regardless of method.
- When used on a large-scale and with minimal personal tutor contact, courseware-based user education is an effective teaching method for the majority of students and additionally has significant economic benefits which personal contact teaching cannot produce.

We concluded that:

- A significant deficiency in all user education practice in higher education is that no systematic attempt is made to identify students who need remedial support in information literacy after they have received user education.
- By integrating user education programmes more closely into large-scale

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IT literacy programmes (which by contrast have established systems for comprehensive assessment and remedial teaching) this deficit can be rectified.

- Because CAL methods are an effective and economic learning method for most students in need of user education, personal contact teaching should be reserved for those who fail to benefit from user education programmes, which should be delivered, in the first instance, via unsupported, courseware methods.
- Information literacy is best developed in the context of mainstream curriculum learning activities. New learning platforms such as VLEs have an extremely important role to play by providing a shared learning space for both information literacy materials and mainstream curriculum learning. The results of such curriculum-integrated computer-based information literacy teaching may in fact be superior to the results of traditional tutor-led user education.

Studies of information literacy evaluation and assessment have concentrated on the assessment of outcomes from user education programmes delivered as self-contained modules. These do not address the issue of how one assesses information literacy attainments (or failures) made entirely within the curriculum context.

An important future research issue will be how failures of mainstream learning achievement can be traced back to failures in information literacy. Although information literacy learning materials may one day be fully integrated into the VLE-based courses they are designed to support, it is still possible to be good at engineering but poor in information literacy. The result may well be manifested as a failure in a core engineering learning goal. Creating a method for the identification and remediation of such failures via systematic assessment is a challenge for the future.

References

Contini, J. and Kaplowitz, J. (2000), "Evaluating computer-aided instruction: a selected bibliography", available at: www.library.ucla.edu/libraries/biomed/people/caibib.html (accessed 1 August 2002).

Cox, A. (1997), "Using the World Wide Web for library user education: a review article", *Journal of Librarianship and Information Science*, Vol. 29, pp. 39-43.

Creanor, L., Durndell, H. and Primrose, C. (1996), "Library and study skills using hypertext: the TILT experience", *The New Review of Hypermedia and Multimedia*, Vol. 2, pp. 121-47.

Currier, S., Brown, S. and Ekmekioglu, F.C. (2001), *Inspiral Project Final Report*, available at: http://inspiral.cdlr.strath.ac.uk/documents/documents.html (accessed 24 July 2002).

Draper, S. (1996), ". . . 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", *Observing, Measuring, or Evaluating Courseware*, available at: http://staff.psy.gla.ac.uk/~steve/Eval.HE.html (accessed 24 July 2002).

GAELS (1999-2001), "GAELS engineering information skills courseware", available at: http://gaels.lib.gla.ac.uk/infoskills1/index.html (accessed 24 July 2002).

GAELS (2000-2001), "GAELS information skills packages", available at: http://gaels.lib.strath.ac.uk/project_info/list.html (accessed 24 July 2002).

Germain, C., Jacobson, T. and Kaczor, S. (2000), "A comparison of the effectiveness of presentation formats for instruction: teaching first-year students at SUNY Albany", *College and Research Libraries*, Vol. 61 No. 1, pp. 65-72.

Getty, N.K., Burd, B., Burns, S.K. and Piele, L. (2000), "Using courseware to deliver library instruction via the Web: four examples", *Reference Services Review*, Vol. 28 No. 4, pp. 349-59.

Joint, N., Kemp, B. and Ashworth, S. (2000), "Information skills training in support of a Joint Electronic Library in Glasgow: the GAELS project approach to library courseware development", *Aslib Proceedings*, Vol. 52 No. 5 , pp. 301-12.

Joint, N., Kemp, B. and Ashworth, S. (2001), "Courseware in academic library user education: a literature review from the GAELS Joint Electronic Library project", *Association for Learning Technology Journal*, Vol. 9 No. 3, pp. 26-42.

Joint, N., Ashworth, S., McLellan, E., Barton, J. and Kemp, B. (2001), "GAELS final report – information environment for engineering", available at: http://eprints.lib.gla.ac.uk/documents/disk0/00/00/00/44/index.html (accessed 2 August 2002).

Kaplowitz, J. and Contini, J. (1998), "Computer-assisted instruction: is it an option for bibliographic instruction in large undergraduate survey classes?", *College and Research Libraries*, Vol. 59 No. 1, pp. 19-27.

Kemp, R. (1999), "Training materials for advanced information skills in engineering and architecture: a Web-based approach to advanced information skills", in Fenton, C. (Ed.), *Building on the Past, Proceedings of the 12th ARCLIB International Conference, 21-23 July 1999*, Arclib, University of Strathclyde and Glasgow School of Art, Glasgow, pp. 10-16.

Lawson, L.V. (1989), "Using a computer-assisted instruction program to replace the traditional library tour: an experimental study", *RQ*, Vol. 29 No. 1, pp. 71-9.

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Lederer, N. (2000), "New form(at): using the Web to teach research and critical thinking skills", *Reference Services Review*, Vol. 28 No. 2, pp. 130-53.
MacColl, J. (2001), "Virtuous learning environments: the library and the VLE", *Program*, Vol. 35 No. 3, pp. 227-39.
Madland, D. and Smith, M.A. (1988), "Computer-assisted instruction for teaching conceptual library skills to remedial students", *Research Strategies*, Vol. 6 No. 2, pp. 52-64.
Martin, A. and Rader, H. (Eds) (2002), *Information and IT Literacy: Enabling Learning in the 21st Century*, Facet Publishing, London.
Michel, S. (2001), "What do they really think? Assessing student and faculty perspectives of a Web-based tutorial to library research", *College and Research Libraries*, Vol. 62 No. 4, pp. 317-32.
Nipp, D. and Straub, R. (1986), "The design and implementation of a microcomputer program for library orientation", *Research Strategies*, Vol. 4 No. 2, pp. 60-7.
Rader, H.B. (2000), "Library instruction and information literacy, 1999 (literature review)", *Reference Services Review*, Vol. 28 No. 4, pp. 378-400.
Reibig, A. (2001), "Citscapes project survey", available at: http://www.citscapes.ac.uk/citscapes/survey.pdf (accessed 24 July 2002).
Salisbury, A.B. (1971), "An overview of CAI", *Educational Technology*, Vol. 11, October, pp. 48-50.
Schutte, J.G. (1996), "Virtual teaching in higher education: the new intellectual superhighway or just another traffic jam?", available at: http://www.csun.edu/sociology/virtexp.htm (accessed 29 August 2002).
Tapscott, D. (1998), *Growing Up Digital: The Rise of the Net Generation*, McGraw-Hill, New York, NY.
Vander Meer, P.F. and Galen, E.R. (1996), "Multimedia: meeting the demand for user education with a self-instruction tutorial", *Research Strategies*, Vol. 14 No. 3, pp. 145-58.
University of Iowa (2001), "TWIST, teaching with innovative style and technology", available at: http://courses.uiowa.edu/twist/index.html

Figure A1 User evaluation questionnaire

Course title:

Course presenter(s): Date:

We wish to evaluate the content and effectiveness of our user education work. Please answer the questions below and return the form to us at the end of the session.

To what extent were you already familiar with the content/skills of this class before the course?

(*circle a number*)

All	Most	Fair amount	Some	None
5	4	3	2	1

How good was the presentation of material to you in this class?

Very good	Good	Fair	Poor	Very poor
5	4	3	2	1

How much did you learn from the course/class?

A lot	Quite a lot	A fair amount	A little	Nothing
5	4	3	2	1

If there were any, how did you find the exercises? (5 being very easy and 1 being very difficult)

Very easy	Easy	Moderately easy	Difficult	Very difficult
5	4	3	2	1

Not applicable

What were the two most interesting/useful aspects?

Please return this form to the course tutors at the end of the session or return to the Andersonian Library, Curran Building, University of Strathclyde.

About the author

Nicholas Joint is Head of Reference and Information at the Andersonian Library, and Senior Research Fellow in the Centre for Digital Library Research, University of Strathclyde. He was the Strathclyde manager of the GAELS (Glasgow Allied Electronically with Strathclyde) project, a SHEFC-funded investigation of electronic library collaboration in the West of Scotland. He is a co-founder member of the steering committee of the International Conference on Information Technology and Information Literacy and is a guest lecturer at the Strathclyde Department of Computing and Information Science. Now a researcher with the Digital Libraries in Networked Environments group at Strathclyde, his work on courseware applications in information literacy has been published in *Aslib Proceedings* and the *Association for Learning Technology Journal*. He is also editor of *Library Review* and can be contacted at: Nicholas Joint, Andersonian Library, University of Strathclyde, 101 St James Road, Glasgow, UK, G4 0NS. Telephone: 0141 548 4640; E-mail: n.c.joint@strath.ac.uk