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Introduction

This article describes the CTI project based at the Department of Accounting and Finance at the University of Manchester. The purpose of the grant was to equip a computer labaratory with IBM PCs locally networked with a hard disk and printers. The development of software, together with suitably constructed databases would enable students to apply the concepts and techniques that they study in a variety of courses. However, it is not simply a question of explaining and evaluating the courseware so developed, its limitations and advantages in aiding the transfer of learning. The project has to be approached from the standpoint of how the results achieved so far provide a more scientific foundation for the production of really useful software.

The project would make two particular contributions:

i) The areas where microcomputers could be effectively used within the accounting curriculum would be investigated and particular teaching applications would be developed. Commercially available software would be evaluated and a representative suite of business applications packages would be selected. The databases would be created in collaboration with the local industrial companies and professional accounting firms. Other courseware would be developed which would enable computing to be integrated into the accounting curriculum.

ii) The case studies and accounting problems which were developed would be made available to other Universities.

In accounting, as Seddon (1987) explained, there are several conflicting reasons for using computers in teaching: namely the need to teach students about I.T. and how to use it (computer literacy); accounting information systems (teaching about computers); and demonstration of accounting principles and concepts (teaching with computers).

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As far as the last objective is concerned, there are also opportunity costs involved and an hour spent on a computer can only be justified if it results in greater benefits to the student than an hour spent learning about the concept using another tool or teaching technique. The aim therefore is to set exercises that are big enough to warrant a computer and short enough to do quickly.

While there are these separate goals in relation to computing and accounting education, they cannot always, nor indeed need they, be kept in separate, watertight compartments. A course that teaches about computers and information systems will necessarily teach students how to use computers, the operating system and some application software. There is no reason why accounting, management and business exercises should not be used to illustrate the use of information systems.

Similarly, if students are using computers as a computational tool to learn accounting concepts, computer practice issues relevant to each exercise can be included to raise the awareness of working in a computerised, as opposed to a manual, environment. This approach is used by Collins et al (1985).

One of the major criticisms of teaching staff who are reluctant to introduce computers into their teaching is that while they can recognise the value of computers for accounting professionals in say, calculating the discounted cash flow of an investment, they cannot see the educational value, over and above well chosen paper and pencil exercises, for students who have to learn to calculate it manually first. Since most people have only seen programs or templates that solve a problem or have themselves designed such a template, they are assuming that either the students will themselves design a simple spreadsheet to solve the problem, which may be relatively time consuming in terms of mastering the computing involved, or that they will make use of a template that will do the calculations for them.

While both of these methods have their advantages under certain circumstances, the criticisms raised do have validity. The point is that to have educational value, the form and the content of the software presentations have to be very different from those used for normal problem solving. Similarly, the type of exercises themselves may also be very different and may result in changes in the way that the subject is taught. Technology structures the way that we perform tasks and a change in the technology will have an impact not just on the courseware, but also on teaching methods, course assessment, the organisation of teaching, staffstudent relations, etc. (Shaoul 1989).

Approach Taken

An extensive search in both the US and UK revealed that it was not possible to use existing courseware either from the textbooks, US or UK courses or any other source. Not only did there appear to be an enormous lack of educational materials in this area, there was an even greater lack of any easy means of finding out what, if anything was available, its uses and limitations. As Bork (1981, 1985) explained, this was unique to accounting but consequent upon the stage of development of instructional computing. Therefore course material would have to be developed which would more adequately reflect modern day use of computers and their applications, using the newer software tools, than was possible on the mainframe. Thus to a large extent we were starting from »Square One« in terms of courseware development.

In general, those teachers wanting to use computers in their teaching were not interested in using/developing computerized assisted learning packages. Some were interested in using computers as a giant calculating tool in problems where the calculations were laborious and trivial and where the issue was to see the impact of changes in the different variables on the solution. This would enable the class to deal with and discuss material that it was not possible to do without a computer.

Others were interested in the potential for using »real« data sets as opposed to the contrived data which had to be used to keep the calculations manageable. This would imply the development of data sets and spreadsheet templates to solve problems. Furthermore the availability of on-line databases of financial information means that students can use the computer to analyse and evaluate the data, using the techniques they have been taught in class and see for themselves the advantages and limitations of different analytical techniques and theories. In this case, students might use commercially developed packages such as Minitab (to do regression analysis) or Lindo (to do linear programming).

The aim therefore was to prepare course materials which could be used on the second and third year courses and would develop the students' analytical and problem solving skills, rather than teach the lower level technical skills (Gronlund 1985, Dreyfus 1986). This has meant that we developed courseware which could be produced relatively quickly and does not require very sophisticated computing knowledge on the part of the student. Only a very elementary knowledge of the operating system and the ability to enter data and move around a spreadsheet are assumend. Furthermore most of the courseware produced does not require the student to spend very much time at the computer.

Clearly therefore it is an approach that it is very different from that taken at other institutions and one that may generate courseware that is of interest and use to others. It can be seen that the approach was one of preparing materials which could be use to explore/cover one topic or issue in an existing course rather than of remodelling the whole course-.

While there are very general guidelines available in the textbooks for the design of software (Alessi and Trollip 1985), there was little available at the start of the project for educational software which was not computer assisted learning, and even less that was relevant for Higher Education or Business Education. Clearly then, any software development would, of necessity, be exploratory in nature, and undertaken with a view to understanding the design issues involved in educational software. Several different approaches and software tools would have to be evaluated.

The development of computer-based course material requires at least two kinds of input, firstly from the accounting teacher who has to design the tutorial exercise/assignment and secondly from the computer personnel who write the software. As the project relies on the University to provide the resources to develop the software, this means that these are very limited.

Given the lack of computer personnel to develop the software, third year students on the joint Honours degree in Computer Science and Accounting were encouraged to take on the development of such courseware for their third year projects. This would enable far more to be developed since they are often more technically skilled than most teachers. They were expected to spend between 60-100 hours on their projects, and preferably to work in groups of three. The use of students to develop software meant that it would be possible to explore the use of different approaches, different software tools as they came on the market and different designs, etc. to accomplish the same task and build up our expertise in this area. It would mean that we would not feel obliged to pursue or use a particular piece of software simply because we had expended so much time and energy on it. Much of the software developed by teachers is very mediocre, as Self (1985) described in his review of educational software, and would never have been used at all if they had not committed so much to it.

Thus it was apparent from the start that courseware development would of necessity take place in a relatively amateurish and empirical way. It had to be seen as an exploratory process. It was envisaged that it might be of more use for the ideas generated than its implementation. Furthermore such an approach would enable us to look at the different ways computers can be used in teaching.

Courseware Developed

Teacher Demonstration of Concepts

This is an area that has been virtually ignored and yet is as important as student use of computers. A study was made of the principles involved in the development and design of courseware which can be used by the teacher to demonstrate concepts and also by the students to acquire the conceptual knowledge. It is important to stress that the development of good courseware does not simply involve the preparation of computer based materials but also includes reworking the way the exercises are set. Since the time taken to perform the calculations is very short, the numerical part (as opposed to the discussive part) of the exercise can emphasise the relationships between variables by requiring recalculations with different values, as well as the technique itself.

This type of courseware is probably of most use in the introductory and intermediate accounting courses which are primarily concerned to impart a wide range of techniques. Teaching at this level usually involves isolating a particular topic, explaining it to the students, giving them exercises to do and feedback as to their performance.

Most spreadsheet templates which are generated by the user from commercial software to solve problems are of little use for pedagogical purposes since they aim to present the finished solution. All the intermediate steps required are not clearly evident in the solution process, thereby encouraging the student, as many teachers have noted, to accept passively the finished solution.

A spreadsheet presentation requires the teacher to plan carefully the sequence and logic of the solution process, i.e. when and how to develop formulas and calculations. In addition, consideration must be given to the theoretical stumbling blocks, calculations, formulas and sensitivity analysis. It has to reflect the thinking process of the user and the individual style of the teacher. It should promote active student involvement in the solution process by requiring the student to check the reasonableness of the answer and encourage students to ask related questions. The solution process needs to be made transparent to the student. Thus courseware is quite different conceptually from a template designed to solve a problem.

From the perspective of students using courseware such as this to acquire the knowledge of the topic area, there are a number of issues raised by this approach. From observations of students' performance in class, where typically exercises are set that require them to do some calculations and then to discuss the issues raised, it appears that they usually attempt the calculations, but if they have had difficulty with the calculations or get them wrong, they are unable (or unwilling to spend the time) to sort it out for themselves before they get to class. Frequently, then, the class time will be used discussing the routine calcualtions rather than the conceptual issues.

Courseware such as this permits the students to rework the exercises as often as they like and to see for themselves whether they have got it right and to go on until they do get it right. Thus they can come to class knowing how to do it and perhaps even more importantly, having done a sufficient number of exercises to have acquired some understanding of the issues so that they can discuss them in class.

The point is that interactive courseware of this sort provides the student with some feedback as to his/her performance, whereas conventional homework does not. This encourages them to persevere until they have completed the work satisfactorily. It is less easy to give up before having mastered the topic. The nature of many exercises that are set (no formal rewards, individual assignments, no obvious »closure« point, etc.) is such that it requires an unusual amount of perseverance to complete it to the satisfaction of the teacher, even though the absolute amount of time may actually be quite short and the exercises themselves are quite interesting, once the students 'get into' them.

Menu driven spreadsheets, using this approach, have been developed for demonstrating concepts in finance.

Simulation

The essence of this approach is to give students computer models which simulate economic processes/consequences so that students can select different input values and compare the outcomes. For example, a process simulation has been developed that calculates the revenue generated from income tax, given different tax rates, tax bands, inflation and unemployment rates. Learning from such a simulation occurs by repeating the process a number of times with different starting values and comparing the results.

In contra-distinction to the previous type of courseware, the solution process is not visible to the students. This is quite deliberate. The calculations are very straightforward and very laborious. There is absolutely nothing to be gained educationally from actually performing the calculations. This particular application is completely menu driven. The students are required to input the data and the program checks that the data are internally consistent so that calculations can be performed correctly. In other words, this approach endevours to ensure that the users cannot make mistakes. If anything, this particular piece of software has been overprogrammed in order to make it fool-proof. The use of the menu forces the student to consciously work through the exercise. No knowledge of Lotus is assumed. In terms of presentation, this type of courseware more closely resembles the more conventional, problem solving software than the type described earlier albeit it a simplified form.

But once again, its value, in terms of the learning objectives, is determined by the kinds of exercises that are set by the teacher rather than simply the software. It can be used to explore the relationships between variables as well as to set revenue goals and explore the different ways this can be achieved.

Simulations typically have a number of major advantages over conventional exercises. Motivation is usually increased since students can see for themselves the consequences of inputting the different values, i.e. they are learning by doing it for themselves rather than passively reading about it. Transfer of learning is more likely to take place since simulation gives the students the opportunity to try out different combinations of conditions and thus be better prepared. The ability to rapidly perform lengthy calculations means that it is possible for students to get a much greater 'feel' for the inter-relationships than is possible using manual methods.

Most computer simulations can be used in a number of ways, but their use is only incidental to the simulation. Without the computer software there can still be a simulation. With the computer software, the simulation, as the real world, can be faster and more creative.

Simulation models permit different forms of exercises to be set because of their 'what if capabilities. Such exercises could take the form of negotiations between different interest groups. Furthermore, the scope of such models and the accompanying supporting materials, often makes it more practical and interesting to assign several students to work together in a group. Thus in addition to changes in performance in the cognitive domain whose objectives emphasise intellectual outcomes such as knowledge, understanding and thinking skills, such exercises also have an impact on the affective domain that emphasises attitudes, responsiveness, appreciation and methods of adjustment (Gronlund 1985).

Such assignments require students to listen to others, be sensitive to the needs of others and accepting of differences. Other objectives include the demonstration of a problem solving attitude, recognition of the role of systematic planning, an understanding of one's own strengths and limitations, co-operation in the group's activities and an objective approach in problem solving.

Instructional Games

These powerful learning tools that are becoming more prevalent. Like simulation, their purpose is to provide an environment that facilitates learning or the acquisition of skills. They often simulate reality and usually provide an entertaining way of practising different accounting and management techniques, e.g. production planning or inventory control.

From a design point of view, these may not necessarily be very different from a simulation (cf. the negotiation process above), although this will of course depend upon the objectives of the instructional game. Elgood (1988) gives a full discussion of the design and educational issues involved. Like simulation techniques, the objectives of such games emphasise the cognitive and affective domain. Games can be used in a number of ways. Students could work in groups, competitively against other groups. An instructional game could be used as an 'ice-breaker' in a tutorial at the beginning of a course.

A hospital management game was developed to test the user's power of analysis against a menu driven Lotus model that incorporates both the financial and non-financial consequences of decision making. It produces a re-iterative model so that the user can learn and develop his/her skills based on evaluated feedback on the previous decisions.

The game centres around a possible dispute over night catering facilities for accident and emergency staff at a local hospital. Financial data on the various courses of action are provided. The user is asked to consider the possible courses of action together with the various manpower problems that they may cause and to chose his/her preferred option. The option is also given to select from a menu, how to deal with the immediate problems of the various factions of staff (porters, surgeons and nurses). Data on staffing levels and bed occupancy rates for previous years are provided together with wage levels and future staff budgets. The user has to devise a staffing strategy for the next few years based on this data and also other information provided as to how the accident and emergency workload is expected to increase over the next few years. The software produces the financial accounts for the year end, based on the decisions made.

Databases

Another major area of importance for integrating computers into the accounting curriculum is the use of databases to bring information concepts and technology into the functional areas of accounting and finance. There are several ways that this can be done.

One such database which has been created, is a management accounting database consisting of a set of twelve monthly managements accounts (i.e. budgeted and actual profit and loss accounts) for one year to enable the management accounting course to be orientated around a real business and the decisions it has to take. It has been possible to obtain the records (sales and production schedules, costings etc.) of a carpet manufacturing company, long since taken over, which has several product lines, cost centres and two operating plants at different locations. The data so obtained enabled the budgeted and actual profit and loss accounts to be calculated. The idea is that students would themselves select and »pull down« the data they need to solve the tutorial exercises from the computer's database. As courseware, such a database would have the benefit of realism, convey the interrelationship of topics and emphasise interpretation and evaluation.

The students would not necessarily use the computer to solve the problem. The issue, as many accounting teachers see it, is that from an educational point of view, the students have to learn to calculate a particular technique manually, without the aid of a computer in the first instance. In any event, in real life, the problem is often one of selecting the appropriate data in the first place. Until now, teachers have had to give students the data. Such an approach means that not only are students learning about different aspects of management accounting, they are also learning how to use information systems and information technology in the context of an accounting course.

The use of financial databases, such as Datastream, is another area that is being developed in many Finance courses. Models can then be developed to analyse subsets of the data. Students should then more readily be able to grasp concepts in finance by using real data in realistic financial models. Again, the emphasis is on exploring the relationships between variables by making use of existing programs or templates.

The database approach is one that lends itself to most courses in the accounting curriculum, for example, the use of financial statement information in evaluating a firm's performance. This would require a database of a number of firms over, say, a twenty year period and software to retrieve the relevant information and analyse the data. Analyses could include: financial ratios, regression and financial projections. Again, menu driven spreadsheets have been prepared for the students to carry out an analytical review, complete with graphical output, of a small sub-set of the data.

Informations Systems as Courseware

The purpose of an information systems course is to give students experience in using and designing an accounting information system and to see how it relates to other parts of the accounting and management process. Commercial packages can be far too complex for students, in the time available, to comprehend fully. Designing a new system, ab initio, is likewise too difficult and time consuming. It was therefore decided to set coursework which involved giving the students a listing of four separate programs which together make up the elements of a very rudimentary inventory recording system so that they could see for themselves the basic elements of an information recording and retrieval system. The use of information systems as courseware familiarises the students with the problems involved in data security, sources of error and the social and organisational problems in using computers.

Most of the courseware described above and that listed at the end of the paper can be obtained via CT1AC.

Discussion

The process of courseware production, implementation, evaluation and dissemination revealed that:

1. The production of good courseware is a team question.
   It requires inputs from the teacher in the discipline area, the programmer/designer with support from Computer Science disciplines, people with expertise in the man/machine interface, i.e. human factors, as well as from the ultimate user, the student. The better courseware had been widely tested. As in the development of all other computer systems, the products were always much more useful and usable, when the users participated actively in the design process, i.e. The question of user involvement is absolutely crucial to good courseware design. Furthermore it raises all the classic textbook issues about the effective introduction of new systems, e.g. staff training and development, project leadership and management, etc., and why systems fail.
2. Production of good courseware is time consuming.
   The expenditure, in terms of time, of all concerned was a nontrivial item, even when the software tools were well-known. Thus our original aim, to produce computer based case studies in a relatively short time, was idealistic to say the least.
3. Courseware can, to some extent, be developed through the teaching process itself, i.e. by students and staff, rather than by the staff alone.

The development of computer-based courseware is a daunting task for those who do not have either the time or the expertise to develop it themselves. Getting students to develop the models as part of their coursework has some obvious educational advantages. It is one way of integrating computing and accounting and teaching information systems design and implementation. This method has only limited uses, but has at least opened up a route for some work to be developed. It permitted the investigation of different design approaches, software tools, etc.

4. Courseware does not have to be large.
   The scale of some of the individual items of courseware being developed, being very modest, enables others to make use of the approach we have taken. (Much of the work in the USA is either keystroking or extremely ambitious). It also means that any such courseware may be very much easier to integrate into the curriculum than a major piece of software, requiring several tutorials if it is to be covered properly.
5. Computers can be used in many different ways.
   It is important to experiment, especially as the hardware and software improves, and to learn from the way that computers are being used in other disciplines. It is not simply a question of investigating what we can do with a computer but rather what we are having difficulty with teaching at the moment in an effective way. Additional supporting materials and new exercises will need to be designed to go with the computer courseware, and it is these factors that will be crucial in determining the educational effectiveness of using computers as a teaching/learning tool.
6. The attempt to integrate computing into the curriculum had an impact on educational practices.
   Teaching methods, course assignments, course assessment, course management, role of the teacher, etc., are affected. The effect of introducing computing is to focus attention explicitly on the learning process rather than on the technology per se. It tends to encourage group and cooperative learning rather than individual and competitive learning. Learning is always a social process, but the use of computers makes this more obvious.
7. There are several aspects to the process of evaluation.
   The software and the supporting material have to be evaluated and revised in order to ensure that it operates properly and deals with the subject matter in an academically sound way. It needs to be tested with small groups of students to get their response, in order to revise such aspects causing difficulties. Lastly, it needs to be evaluated with large groups to check for example, that computer response time is

satisfactory. Clearly, in the early stages of developing courseware, not all the software survives rigorous testing.

8. Dissemination of courseware is not a simple issue.

It should be clear from the above, that although one of the objectives was to disseminate the courseware so developed as a result of the CTI grant, it is far from clear that all the materials warrant publication and that other teachers are willing or able, for a whole number of reasons, to make use of them in their courses. Courseware produced by enthusiastic academics/teachers is rarely usable by others. This was found also to the case for materials published commercially. Furthermore, it is extremely time consuming to test out other people's software. Most people chose software on the basis of word of mouth recommendations. It is suggested that the major value in circulating software lies in the ideas and concepts embodied in the software rather than in the software per se.

A simple means for disseminating courseware is required and the new centre (CT1AC) will be useful (Kaye 1989). However it is not enough to have a directory of software for teaching purposes. Additional mechanisms are needed, such as journals, software reviews in the journal relating to the relevant academic discipline (as opposed to a computing or educational journal), and conferences/workshops which enable prospective borrowers to try out and discuss software with others. It is Utopian to expect others to be able to use courseware without a high degree of knowledge of the issues involved. This raises the necessity of staff training and development in instructional computing.

The Use of Databases

The major area of development made possible by the CTI grant has been the management accounting database. As a result of the work done so far by students, funding has been obtained for two research assistants to carry out further research into the use of databases for teaching. This illustrates that major resources are necessary if we are to go beyond the cottage industry nature of courseware development which has characterised the project so far.

It is intended to develop a computerised database that can be used by both teachers and students on accounting courses as a study resource. The first stage is to develop the software that would enable it to be used as the basis for tutorial exercises for the whole of a second year management accounting course. Its significance and value lies in the fact that it would enable students to solve traditional management accounting problems with a realistic set of data and to compare their answers and solutions so obtained with what actually occurred. Thus the whole course could be focused around a real company.

Although the database would be stored on computer files, the purpose is not to teach computing skills but accounting principles and concepts. By requiring students to make use of a computerised database as an integral part of their work, it is hoped that they will learn to use computers in a more realistic context, their uses, both potential and actual, and their limitations and perceive the necessity for acquiring the appropriate skills.

Previous research and development into the use of computers for teaching, both in the UK and abroad, have stressed computer aided instruction techniques, the role of the computer as a calculator and its use for model building, etc., (all valuable in their own right) rather than its use for information retrieval in problem solving.

Publications

Most of the points raised in this discussion are elaborated more fully in various publications relating to this project which are listed at the end of this paper.

Conclusions

We are only now gaining the experience that may lead to the effective production of courseware. It is a lengthy process and we are only just beginning to understand it. Future work will be able to take advantage of the superior hardware: colour, enhanced graphics and parallel processing to aid students' comprehension of abstract concepts.

A major task that requires to be done is to review all the ways that computers are used in Higher Education in order to provide insights in to the factors that aid the transfer of learning. While such research has been carried out in relation to instructional computing for schools, such research is concerned with learning at a different stage of cognitive development.

The costs of research and development are far from trivial and will require additional sources of finance. The effect of the new technology in teaching is bringing about an analagous situation to that obtaining in manufacturing industry. Direct costs, in this case teaching time, will decline relative to fixed costs, equipment. But more importantly, the production costs (of teaching undergraduates) will decline relative to development costs. It will entail a change in the teacher's role from delivering information to designing courseware as part of a team.

The achievements of this project do not appear to be substantially different from those reported in the CTISS file. Bork (1981, 1985) drew very similar conclusions and made a number of important recommendations, all of which are endorsed by this paper. Output from CTI projects such as this is not simply the amount of really useful software, but an analysis of what constitutes useful software and the process by which it can be achieved. Research of this sort combined with continued and secure funding should enable work to proceed on a more scientific basis. This has been the major value of the CTI project.

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Courseware Developed

1. Stock recording system and associated data files
2. Plant closure model
3. Tax revenue generator
4. Model showing the relationship between different sales patterns and working capital
5. Gilt models
6. Fixed cost allocation using three methods
7. Calculation and diagnosis of standard cost variance
8. Analytical review of a company
9. Portfolio game
10. Hospital Management game
11. Trial Balance adjustment package
12. Management Accounting Database
13. Impact of Interest Rates on Income Distribution
14. A Comparative Advantage model
15. Joint Cost Allocation Model

Publication relating to the Project

Newman M., O'Hara M.J. and Shaoul J.E. incorporating Project Work into Information Systems Development Teaching: One Department's Experience.« Paper presented at the 1STIP Confernce (Information Systems Teaching: Improving the Practice), at the Civil Service College, Sunningdale Park, Berkshire, March 1988.

Shaoul J.E.»Impact of New Technology on Accounting Education«. Paper presented at the European Conference of the International Business Schools Computer Users' Group, at INSEAD, Fontainbleau, April 1988.

Shaoul J.E. »Sharing Accounting Courseware«. Paper presented at a conference on »Sharing Accounting Courseware« at Manchester University, March 1989.

Shaoul J.E. »Teaching With Computers«. Paper presented at the 12th European Accounting Association Conference, Stuttgart, Germany, April 1989.

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