

Changing Practice in Accounting Education
– Experimentation, Innovation, and
Encouragement



Alan Sangster

PhD by Publication

2008

***Changing Practice in Accounting Education – Experimentation,
Innovation, and Encouragement***

Alan Sangster BA MSc CA Cert TESOL

Middlesex University Business School
The Burroughs
Hendon
London NW4 4BT

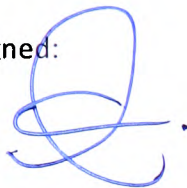
A thesis presented in partial fulfilment of the requirement for the award of the degree
of Doctor of Philosophy of the University of Glamorgan

September, 2008

Declaration

This is to certify that the work submitted in this thesis under the title "*Changing Practice in Accounting Education – Experimentation, Innovation, and Encouragement*" is the result of original research. It has not been submitted for any other award.

Signed:

A handwritten signature in blue ink, consisting of several loops and a horizontal stroke, positioned to the right of the word "Signed:".

Alan Sangster

30th September 2008

Acknowledgments

First and foremost, I would like to thank all 23 co-authors with whom I have worked during the past 20 years. In particular, I would like to thank Alan Wilson, David Rawlinson, Christina Mulligan, Andy Lymer, David Tyrrell, the late Sally Aisbitt, Pat McCarthy, and Greg Stoner, the co-authors who were involved in outputs included in this thesis. Without all your help, I would have learnt less, done less, and made many more mistakes.

My thanks go to my supervisors Neil Marriott and Pru Marriott for their constructive comments, encouragement and support; and to Nigel Brown, Reg Mathews, and Robert Onions for encouraging me to prepare this thesis.

Dedication

I do not believe in reinventing the wheel, nor do I believe that we have yet come close to the potential we have to make change in the future lives of our students. The “not-invented-here” syndrome is alive and well as we continue to ignore the educational changes and innovations that others have found useful. Many of us have been discouraged from undertaking replica studies based on other people’s research as they make very “little contribution to knowledge”. In the UK, educational research is disparaged and undervalued by the academic accounting community and it appears to be thoroughly off-limits for anyone in the academic finance community anywhere – I have not read all the accounting and finance education literature published over the past 20 years, but I have read a lot of it and I can only recall ever reading two academic articles that were focused solely upon the teaching of finance.

This is all so misguided. If we accounting and finance educators replicate the successful innovations of others, we shall contribute to our own knowledge and experience: we shall learn something new, be it positive or negative, and change our thinking and perceptions; and we shall become more effective educators as a result. Instead, we wander like lemmings onto our virtual campuses, dump all our course notes and *PowerPoint* files in virtual post boxes where students can collect them in advance of classes which they then do not attend because they can see no benefit in doing so. We then wonder why our standards are dropping and/or our failure rates are rising.

The accounting and finance academic community does not train educators effectively, nor encourage them to become significantly better educators by challenging their own comfort zones. I was very lucky in the first nine years of my career as an academic: I had three department heads in three different institutions, all of whom encouraged me to develop my skills as an educator, to learn from experience and, most of all, to have the courage to do what I felt was best for my students. The first never criticised me for my mistakes but quietly moved me to “safer” modules the following year and left me in peace to learn from my mistakes. The second encouraged me to experiment and to write-up and publish the results of my work and pointed me in the direction of a colleague who then mentored me in my earliest years of research. The third encouraged me in every

way he could and when he did not have the funds to support something I wanted to do, he went out and found them.

This thesis is dedicated to these three men: Andrew Greg, Peter Pope, and Bob Perks but, most of all, it is dedicated to my two children, Douglas and Emmanuelle without whose acceptance of my nomadic academic life I would not have completed most of the work contained in this volume. Thank you all.

Abstract

This overview provides a summary of research that explores factors that affect the learning experiences of accounting undergraduates in Higher Education. The submission is based on eleven outputs, the research for which and publication of which spans the period 1988-2007. The outputs relate to the theme of improving or enhancing student learning and encouraging students to “learn how to learn” and to become lifelong learners.

It starts with an overview of my career as a teacher, educator, and researcher which traces how I have developed during my career from an untrained and generally clueless teacher to someone who was passionately interested in developing the abilities of my students and motivated in both my teaching and research to convert them into lifelong learners.

This is followed by a discussion of each of the eleven publications included in this thesis. Beneath the umbrella of the overall theme of encouraging students to “learn how to learn”, these publications are organised into two themes [*The Use of IT in Teaching and Learning*; and, *Using Accounting History to Increase the Relevance of Topics to Students*] and a number of sub-themes.

Together, these publications represent significant contributions to knowledge. These include:

- being the first author in accounting education to demonstrate that asking students to prepare flowcharts of the rules in rule-based topics such as accounting standards may improve their performance in assessments;
- the first review of the use of IT in accounting education to focus upon the adoption of computer based instruction;
- the first paper (and the only one that I am aware of) that considers whether or not using computer based instruction as an additional, non-integrated into the course resource is a worthwhile use of resources;

- the first paper I am aware of that presented data that supported the view that computer based instruction could replace lecturers with no impact on performance of the students;
- the first paper published to foresee the impact *World Wide Web* may have upon accounting education and research;
- the first time I am aware of anyone presenting results of a teaching innovation that involved use of the web where students were successfully guided outside their comfort zones;
- the first paper to ever present an overview of how the *World Wide Web* was being used globally in accounting and finance education;
- the first paper I know of that presented a case study of learning and assessment that showed that student performance on objective tests had a strong positive correlation with their performance on traditional written examinations and demonstrated that objective tests could guide student learning to the extent that they appeared to have directly impacted students' deeper understanding of their subjects;
- the first paper to use a modern day learning materials developmental model to demonstrate that the bookkeeping treatise of Luca Pacioli published in 1494 was as carefully written as today's textbooks.

My contribution to knowledge is then summarised and the number of citations of each publication according to Google Advanced Scholar is given, including the date of the latest citation. This is then followed by a list of all my publications. Signed letters from my co-authors confirming my involvement in joint authored work are presented, followed by a list of the eleven publications included in the thesis. Finally, all eleven publications are presented.

Table of Contents	Page
Declaration	iii
Acknowledgements	iv
Dedication	v
Abstract	vii
Table of Contents	ix
List of Tables	xiv
Critical Overview	1
1. Introduction	1
2. My Development as a Teacher, Researcher, and Academic	5
3. The Published Outputs	27
3.1 The Use of IT in Teaching and Learning	27
3.1.1(a) In General	
Output 1 <i>Knowledge Based Learning within the Accounting Curriculum</i>	27
The British Accounting Review, Vol. 23, No. 3, September 1991, pp. 243-61. (with Alan Wilson)[50% contribution]	
3.1.1(b) Computer-based Instruction: Outputs 2, 3, and 4	30
Output 2 <i>Computer-Based Instruction in Intermediate Accountancy Courses</i>	30
In the proceedings of The Integration of Computer Based Training Materials in Higher Education Conference, Bradford University, December 1991, Holmes, G. (ed.) <i>Integrating Learning Technology in the Curriculum</i> , CTESS, 1992, pp. 44-8.	

Table of Contents (continued)		Page
	Output 3 <i>Computer-Based Instruction in Accounting Education</i>	32
	Accounting Education, an international journal, Vol. 1, No. 1, 1992, pp. 13-32.	
	Output 4 <i>EQL Bookkeeping - the demise of the lecturer?</i>	34
	In the selected proceedings from the 3rd Annual CTI-AFM Conference, Bradford, April 1992, Williams, B.C. and Nicholson, A.H.S. (eds.), pp. 31-40. (with David Rawlinson) [30% contribution]	
3.1.1(c)	Computer-based Assessment: Outputs 5 and 10	36
	Output 5 <i>Objective tests, learning to learn, and learning styles</i>	36
	Accounting Education, an international journal, Vol. 5, No. 2, 1996, pp. 131-46.	
	Output 10 <i>Using Internet-based On-line Assessment: A Case Study</i>	41
	Accounting Education, an international journal, Vol. 14, No. 4, 2005, pp. 383–94. (with Sally Aisbitt) [50% contribution]	
3.1.1(d)	The Internet and World Wide Web: Outputs 6, 7, 8, 9, and 10	44
	Output 6 <i>World Wide Web – what can it do for education?</i>	44
	Active Learning, Vol. 1, No. 2, 1995, pp. 3-8.	
	Output 7 <i>Integrating the World Wide Web into an accounting systems course,</i>	45
	Accounting Education, an international journal, Vol. 6, No. 1, pp. 53-62. (with Christina Mulligan) [80% contribution]	

Table of Contents (continued)		Page
	Output 8 <i>How to survive a new educational era</i>	47
	Issues in Accounting Education, Vol. 13, No. 4, 1998, pp. 1095-1109. (with Andy Lymer) [80% contribution]	
	Output 9 <i>Insights from internet-based research: Realising a qualitative understanding from a quantitative search process</i>	48
	in 'The real life guide to accounting research', Humphrey, C. and Lee, B. (eds.), 2004, pp. 309-24. (with David Tyrrell) [50% contribution]	
	Output 10 <i>Using Internet-based On-line Assessment: A Case Study</i>	50
	Accounting Education, an international journal, Vol. 14, No. 4, 2005, pp. 383–94. (with Sally Aisbitt) [50% contribution]	
3.2	Using Accounting History to Increase the Relevance of Topics to Students: Output 11	51
	Output 11 <i>Lessons for the classroom from Luca Pacioli</i>	51
	Issues in Accounting Education, Vol. 22, No. 3, 2007, pp. 447-57. (with Greg Stoner and Pat McCarthy) [60% contribution]	
4	Concluding Statement	55
5	References	61
6	List of Total Publications and Research Funding	64
7	Confirmations of Contribution	76

Table of Contents (continued)		Page
7.1	Output 1: Sangster, A. and Wilson, R. A. (1991), <i>Knowledge Based Learning within the Accounting Curriculum</i> , The British Accounting Review, Vol. 23, No. 3, pp. 243-61. [50%]	77
7.2	Output 4: Rawlinson, D. and Sangster, A. (1992), <i>EQL Bookkeeping - the demise of the lecturer?</i> , In the selected proceedings from the 3rd Annual CTI-AFM Conference, Bradford, April 1992, Williams, B C and Nicholson, A H S (eds.), pp. 31-40. [30%]	78
7.3	Output 7: Sangster, A. and Mulligan, C. (1997), <i>Integrating the World Wide Web into an accounting systems course</i> , Accounting Education, an international journal, Vol. 6, No. 1, pp. 53-62. [80%]	79
7.4	Output 8: Sangster, A. and Lymer, A. (1998), <i>How to survive a new educational era</i> , Issues in Accounting Education, Vol. 13, No. 4, pp. 1095-1109. [80%]	80
7.5	Output 9: Sangster, A. and Tyrrell, D. (2004), <i>Insights from internet-based research: Realising a qualitative understanding from a quantitative search process</i> , in 'The real life guide to accounting research', Humphrey, C. and Lee, B. (eds.), pp. 309-24. [50%]	81

Table of Contents (continued)		Page
7.6	Output 10: Aisbitt, S.A. and Sangster, A. (2005), <i>Using Internet-based On-line Assessment: A Case Study</i> , Accounting Education, an international journal, Vol. 14, No. 4, pp. 383–94. [50%]	82
7.7	Output 11: Sangster, A., Stoner, G., and McCarthy, P. (2007), <i>Lessons for the classroom from Luca Pacioli</i> , Issues in Accounting Education, Vol. 22, No. 3, pp. 447-57 [60%]	83
8	Complete Submitted Publications	85
8.1	List of Submitted Publications	85

List of Tables

	Page
1	Final Summative Performance (Output 5) 39
2	Form of Output 56
3	Contributions and Citations 56

Critical Overview

1. Introduction

My main motivation in my work is to find ways to improve or enhance student learning and encourage students to become lifelong learners by:

- showing them how to organise their thinking, their planning, their studying, sometimes their lives by focusing on the goals they seek to achieve and the barriers they need to cross, so that they achieve a greater proportion of their potential than would otherwise have been the case;
- enabling them to achieve academic goals they believed were beyond them;
- guiding them along study routes that encourage them to learn as they progress, rather than by cramming at the end of their course, while also demonstrating to them through their own achievements the benefits of doing so; and,
- seeking contexts within which they can see the relevance of the topics they are studying and so view accounting as a social science, as an element of the world around them that helps processes and activities to function effectively, rather than as a mechanistic process for recording transactions and converting the resulting data into information in a meaningful way; and so enabling them to engage with their topics of study, understand their topics better, and be better prepared for life after graduation.

If I were to sum it all up in one phrase, I would say that I want students to “learn how to learn”.

In this thesis, I present a theme of work comprising 11 publications. The work reported in these publications spans a 20 year period from 1988 to 2007. It concerns experiments and innovations undertaken in order to guide and improve student learning and papers written in order to encourage fellow academics to embrace new technologies and the history of accounting in their teaching and, by doing so, encourage their students to engage better and to “learn how to learn”.

My pedagogical work and thinking has developed and shifted over time, usually not as a result of direct exposure to the work of others described in journals and at conferences. Rather, it is largely a result of my own experiences, of chance

conversations on rainy afternoons and sun-drenched beaches, of accidentally sitting next to someone at a conference dinner who put an idea into my head, and of inspirational moments when I recall something I had seen or heard that I could perhaps use in a different discipline and context.

As a result, this thesis starts with an autobiographical outline of my development as a teacher, researcher and academic. In doing so I seek to show how my views and perspectives were fine tuned and altered. Showing how I “learnt by doing”, by stretching boundaries (as I was taught when studying advanced linear programming for my MSc in 1985) and breaking constraints (i.e. rules or norms) in order to identify whether in doing so an improved result might be obtained, the benefit of which outweighs the cost of breaking those constraints.

The minor battles I fought over the first ten years or so of my research activities prepared me for the two major boundary stretching and constraint breaking efforts of my career. The first arose when I attempted to put all my experience into practice at the Open University (Output 10). I faced the second when presenting papers on my research findings relating to the integration of accounting history into the teaching of accounting and, in particular, double entry bookkeeping and the treatise on the topic written by Fra’ Luca Pacioli and first published in 1494 (Output 11).

In the latter case, my research findings contradict the well-respected and entrenched views of many distinguished scholars, none of whom I would chose to offend, some of whom were reviewers of the papers I prepared, and some of whom were present or had their views represented at presentations I made at conferences in the UK, France, Spain, Italy, Canada, and the United States. Not surprisingly, convincing some of these scholars that their long-held views are incorrect is extremely difficult.

I must acknowledge that I was fortunate to conduct my research on this topic when I did. The *World Wide Web* was beginning to emerge as a useful and a more-reliable-than-not research resource in 2005 and it truly is now a “library on your desktop” (Output 6). It is also a goldmine for Italian research literature and relevant but rare books relating to my topic of interest – either for purchase or for access to digital versions. It is a resource which simply did not exist for previous generations of

researchers. If it had, I am sure my view and those of other English language scholars would be more closely aligned than they are at present.

The difficulty I experience in presenting my findings which portray such contrasting views compared to those of these scholars is great, sometimes intimidating, but never a waste of time. Italian accounting students and accounting historians have known of the issues I am writing about for over 100 years, but they have remained buried in hard to find and harder still to subscribe to Italian academic journals and limited edition books in Italian. It is with some pleasure that I have made friends with some of the Italian accounting history community who are sympathetic to what I am writing.

The most useful advice I have ever received concerning research was given to me at a conference in Nantes in 2006 by one of the most renowned non-Italian Pacioli scholars still active in research: “If you want to research this area, you need to read the [inaccessible] Italian literature” – wonderful advice, but so intimidating that I felt compelled to force myself to be able to understand the Italian books and articles I found rather than seeking an Italian co-author who wrote good English. Yet, like all challenges successfully mounted, the benefits of having done so and being able to write and speak with authority and debate with the established experts on the subject using sources written in a language other than my own was illuminating and a very moving learning experience. “Where there is a will, there is a way” ought to be engraved on the hearts of all educators who aspire to show their students how to “learn how to learn”.

For me, it has been a very interesting learning curve that I have been following since 1988. I have learnt how to learn from my experiences and continue to do so. I believe I have succeeded at times in showing my students how to do so as well. As to whether I have managed to influence my fellow academics significantly, and could thereby claim to have made a positive impact upon their efforts to enhance the learning of their students: I know I have in some cases, but not nearly to the extent that makes writing-up and publishing this work a truly satisfying process. Writing-up research for publication can be illuminating but it is generally more of an altruistic process requiring much time and effort with only minimal perceivable resulting impacts on anyone other than oneself. It can be frustrating and, as I shall explain at the appropriate time later in

this thesis, can ultimately lead to a dramatic change in scholarly focus, such as the one I undertook in 2005.

2. My development as a teacher, researcher, and academic

By challenging ourselves, we learn, and this is what we need to teach our students to do. We learn by doing and learn through reflection about our experiences. I began teaching in September 1983 and, like most university academics I know who started teaching around the same time, I received no training of any kind. Even though I wanted to be trained to teach, I could not enrol on a teacher training course: there was a four-year waiting list for the in-service teacher training course at the local teacher training college. Untrained, I chose to adopt the teaching style of my history teacher at school: a talking book. I presented didactic lectures in which I read from my hand-written script and expected the students to write down every word and then memorise what they had written and regurgitate it in their exams.

It did not take me long to learn that I was making a big mistake: one entire cohort of around 25 postgraduate students all stopped attending my classes at the same time mid-way through my first term of teaching. They never came to another of my classes, and none of them ever spoke with me again, though I turned-up every week at the appointed hour. Letters elicited no replies, though all but one of the students did complete the assignment they were required to do in order to be able to pass the module; and all 25 sat and passed the exam. The one student who refused to complete his assignment wasted an entire year – he could not graduate and obtain his post-graduate diploma. To my knowledge, he never did. I shall never forget him and the impact that his reaction to my incompetence as an educator had upon my career.

As a result of the “strike” action of those students, I abandoned dictation in all but one of my modules at the start of the second term and started using overhead transparencies that I “sensibly” erased after each lecture so that I could use them again to write the overheads for the next lecture! (Someone in the department had told me that they were very expensive and that I could not have very many.)

I never dictated another lecture after the end of that academic year, and reacted to my awareness of my clear lack of teaching expertise by volunteering to attend a two-week course on small business teaching at Durham University Business School in July 1984. I learnt a lot there about how to challenge students and make them think. After the course, I knew that I had to challenge myself, to come out of my comfort zone and

start looking for ways to make students engage better with subjects they really were not motivated to study.

Higher education has changed considerably since I began teaching in September 1983. Colleagues were amazed that I requested and received a printer and a pc on my desk upon my arrival – the only pc in the entire college! In those days, conditions were such that I typeset my own exam papers, which no-one reviewed before or after they were ready. In 1985, I was involved in the first computerised financial accounting examination that I am aware of which required students to use spreadsheet software to prepare a profit and loss account and balance sheet.

During the four years from 1983 to 1987 that I spent as a lecturer at The Queen's College, Glasgow [a small central institution (i.e. polytechnic), which is now part of Glasgow Caledonian University], I was twice involved in developing new courses and in responding to the enquiries of the accreditation team sent to validate what we proposed. However, the accreditation teams only looked at the proposed course syllabuses, aims, and objectives, not at the proposed assessments, and never at the courses after they were approved. Despite my teaching at all levels from Higher Certificate and Diploma to final year undergraduate, to postgraduate diploma, I never once in those four years encountered an external examiner on any of the courses I or anyone else taught and examined.

Second marking, even of a minimal nature, was non-existent, but I did not realise the dangers of this lack of audit and control until I was in my fourth year in the job. That summer, my final year students were presented with an externally set final examination paper on hotel accounting that included one question that was impossible to answer, and three others with ambiguous text and missing information that made the likelihood of anyone getting a "correct" answer a lottery. Only three of the seven questions on the paper could be answered other than by guesswork.

I wrote to the examining body about this on the same day that the students sat the exam. It was not just students at my college that were affected. All the hundreds of students who sat that examination that year in the UK were in the same situation. Nothing I know of was ever said publically about that exam paper by the examining

body and I saw no published comments concerning it, nor did I ever receive so much as an acknowledgement of receipt of my letter.

This experience had a major impact upon the rest of my career. It led to my willingly undertaking external examining (twelve PhDs, one DBA, one MPhil, and the undergraduate and/or masters level degrees of fourteen UK and Irish university departments). I also took on the role of stream moderator for one of the UK CCAB institutes (where I saw many instances in draft exam papers that were similar to those I had encountered in 1987); and becoming involved in the accreditation of dozens of proposed and existing degree programmes. Most of all, it led to my long-term interest in assessment.

In October 1987, I moved to Strathclyde University and conducted the first pedagogic research of my career in 1988/9. It involved students preparing flowcharts and building expert systems for a number of accounting standards (Output 1).

I moved to Aberdeen University in 1989 and the accounting systems module at Strathclyde reverted to the traditional model which had been in place before I taught it in 1988/9. Even though I wrote Output 1 describing this project, I was blind to the knowledge I had gained through the research: that preparing flowcharts assisted learning of a rule-based subject. It took me a further 19 years to finally realise what I had learnt. In 1989, it seems that I viewed writing-up the research as being more important to me than learning from it. This is not what undertaking research should be about, and I am relieved that this is the only such example I am aware of in my career, but it is a lesson that all new researchers would do well to recognise: reflect.

Before I left Strathclyde, one of my colleagues (who had taken some of the tutorials in 1988/9) suggested that I contact a publisher and ask if it would be interested in a textbook on accounting standards based on mini-case scenario questions of the type I had used in the tutorials. While incorporating expert systems into the book was impracticable, flowcharts were not. John Blake had been using them in his accounting standards textbook since it was first published in 1981 and I had used the second edition when planning my lectures (Blake, 1988). It was this book which had given me the idea of requiring students to prepare flowcharts.

My book proposal was accepted. It covered all extant UK accounting standards, with sections on problematic elements of each standard, at least one flowchart for each standard, and hundreds of mini-case scenario questions of the type I had developed for the tutorials. The book (*Workbook in Accounting Standards*) was first published in 1991 and went through three further editions (1993, 1995, and 1997) before I decided I did not want to create any more mini-case scenario questions and declined the invitation from the publisher to publish a fifth edition. Despite being over 10 years since the last edition was published, in 2007 it was still in use in at least one UK university and was considered sufficiently relevant to be cited in a paper published in the *International Journal of Financial Services Management* in 2006 (Tahinakis et al. 2006).

[The editor responsible for the book brought it to the attention of the textbook author, Frank Wood who, in 1993, was so impressed by the clarity of my writing style and by the novel pedagogical approach I had adopted, he invited me to become co-author of his top-selling textbook, *Business Accounting*.]

In 1990, my head of department at Aberdeen University obtained funding from a local company and, knowing of my interest in using IT in teaching, he suggested that I might like to use it to purchase a site licence for a new teaching product, the computer-based instruction (CBI) package: *PEER Accounting Standards*, to use on a level two financial accounting module. I accepted his offer and introduced *PEER* into my teaching in 1990/1. This led to my experimenting with “supplantive” use of CBI. That is, I asked the students to learn some of the topics from *PEER* and did not include those topics in my lectures: *PEER* was the instructor for those topics. I also looked at “supportive” use of *PEER*, by suggesting that the students use *PEER*'s material on the standards I was teaching in my lectures as an additional resource to reinforce the learning they had undergone in my lectures.

This work with *PEER* led to the publication of Outputs 2 and 3 and marked something of a watershed in my understanding of the benefits of computer-based instruction. Output 2 was a literature review of use of computerised instruction and Output 3 described the *PEER* innovation of 1990/1.

Unfortunately, the findings I presented in Output 3 appear to have been largely missed by my peers. In my role as an external examiner I have many times encountered both supplantive and supportive use of proprietary CBI but I have yet to encounter an instance where overall performance was known to have “improved” as a result and many where performance was below expectations. The reaction in the case of the latter has always been to blame the CBI, but in no case that I have encountered was any attempt made to effectively integrate the CBI into the course.

Anecdotally, there still appears to be a lack of awareness among accounting educators of how to use CBI effectively, something that was very evident in the literature 20 years ago and which I then put down to a lack of teacher training among accounting academics. I would now adjust what I concluded in 1991 to say that, despite various government funded initiatives (e.g. the Computers in Teaching Initiative, the Teaching and Learning Technology Programme, and the Higher Education Academy subject centres and Centres for Excellence in Learning and Teaching) there still appears to be a lack of *appropriate* teacher training for UK accounting academics *on the integration of IT into modules and courses*.

In 1991/2 I repeated this type of innovation, but on the subject of bookkeeping. The findings were similar. This innovation is the subject of Output 4. I used the results of my analysis of both these CBI studies eight years later to justify delivering tuition in bookkeeping solely through the *EQL Bookkeeping* package when I created the 60-credit *Certificate in Accounting* course at the Open University.¹ Despite considerable resistance within the university to my doing so, this proved very successful – all the 550 students successfully passed their 20 question objective test-based bookkeeping assessment (which is more than can be said for the 45 tutors employed on the course!), though some did so only after multiple attempts.

This reinforced what I had thought after completing the research relating to Output 4 in 1991/2: that the extremely mechanistic, rule-based nature of bookkeeping does not require any direct human input in its instruction, so long as students are motivated to learn it well enough to pass their assessment. (At the Open University, the students

¹ The Open University course is the subject of Output 10.

were told they had to pass the assessment in order to continue on the course and that passing it would give them the right to apply for membership of the then Institute of Bookkeepers. When it became apparent that this was the only way we could include bookkeeping in the course, I negotiated this accreditation. It gave students an exit route if they later found the *Certificate in Accounting* too difficult or too much for them to do.²)

Over the four academic years 1991/2 through 1994/5, I continued to develop the accounting standards course, changing content, delivery medium, summative assessment, and introducing computer-based assessment. I also started to look at the relevance of learning styles to student learning. During those four years, I encountered some resistance from colleagues to what I was doing. For example, in 1991/2, one senior colleague questioned whether it was sensible to double the number of standards covered in the module compared with 1989/90 but accepted that my 1990/1 exam results suggested that I had been correct in thinking that through integration of CBI the students could learn about more standards than was previously thought to be possible. However, it was the introduction of computer-based assessment that met greater resistance from colleagues.

In 1991/2, I integrated computer-based assessment (using the *QuestionMark* package) into the accounting standards module. Students used *PEER* to self-instruct themselves on a series of accounting standards and then sat computerised 10-minute objective tests of between 25 and 40 questions each. Students had to achieve an overall average of 50 per cent across the objective tests in order to be allowed to sit the final examination.

In 1992/3, three changes were made:

- a file server was used instead of floppy discs to store each student's objective test answers and scores;

² There was rather more to this than simply forcing the students to learn how to do double entry on the Open University course. I wanted them to have (a) practice in learning in this way as most of the sixteen 100+ page course books had CBI material integrated within them; and, (b) practice in using the online objective testing assessment package, *QuestionMark Perception*, before they had to undertake any of the six online 100-question summative objective tests embedded into the course.

- the objective test part of the final examination (which represented 50 per cent of the assessment on accounting standards) was switched from being a paper-based part of the exam paper to a 20 minute computer-based summative objective test held a week after the last tutorial; and,
- under pressure from colleagues, the requirement for a 50 per cent overall average was dropped and replaced with the requirement that students achieve a minimum of 40 per cent on each tutorial's objective test.

My colleagues had felt that 10 minutes was too short for the summative objective test and wanted me to allow the students 30 minutes. We compromised on 20, which proved to be unnecessarily long but at least it did no harm: one student did take the whole 20 minutes but most had left by the time 10 minutes had passed. However, the removal of the 50 per cent average appeared to have a negative impact upon performance, but I was unable to convince colleagues of the benefits of reinstating it.

Following removal of the objective test questions from the written exam, the time allowed for the exam was reduced by 30 minutes to an hour-and-a-half. One-third of the marks were allocated to a question on accounting standards. However, two years later (in 1994/5) the essay question on accounting standards became optional. Colleagues felt that as a result of all the continuous assessment in my half of the module (the other half was on other elements of financial accounting), there was too much assessment on accounting standards in the 30-hour module. My colleagues were very worried that students might complain that they were being over-assessed by me on that module, though none ever did.

During 1992/3 and 1993/4, I also looked at the learning style preferences of these students using the Honey and Mumford *Learning Styles Questionnaire* (LSQ) (1992) in order to see if there was any relationship between approach to learning and performance.

Output 5 describes all the innovations and investigations I undertook on this module. However, it was not the only module in which I was undertaking this type of innovation: I was continuously seeking other ways to appropriately integrate IT into my teaching and assessment. In 1994/5, I introduced a ten-minute 20 question formative

objective test using *QuestionMark* at the beginning of each of ten tutorials (weeks 2 - 11) on a level one 12-week management accounting module. In the 12th and final week of the semester, students sat a ten minute 20-question objective test using *QuestionMark*. In order to be allowed to sit the examination, they had to achieve 40 per cent in the test. The 15 or so who failed it had an opportunity to take another test, which they all passed.

The previous year, the pass rate on the module had been so poor that the lecturer had resigned. There were 140 students on the module and the pass rate in 1994/5 was 100 per cent. Unfortunately, I was involved in other research during the following year and then moved from Aberdeen to Queen's University, Belfast before I had an opportunity to write-up this work for publication.

For the management accounting module mentioned in the previous two paragraphs, I also introduced what was possibly one of the first email discussion lists for a class in the world. Through it I answered questions from the students and circulated handouts and additional spreadsheets to aid their learning. I also established the first website for a UK accounting department, with web pages for individual modules. I placed all my management accounting module lecture notes, handouts, and spreadsheet material on the module webpage immediately after I had prepared them. The students received a hard copy of all the lecture notes at the start of the module. (Despite this, attendance at the lectures was consistently high.) To obtain hard copies of the other material, they had to download it and print it. The student feedback for the module indicated that they had found my use of the Internet on the module extremely useful.

Since early 1994, I had also been using the *World Wide Web* (the web) increasingly in my research and the benefits that this new technology could bring to both education and to research seemed obvious to myself and others who had used it. However, few of my colleagues seemed willing to take the time to learn how to use this new technology and were, as a result, hard to convince of its potential.

I resolved to do something about this and, in 1995, I wrote a paper outlining the advantages as I saw them of integrating the Internet into teaching and research and

presented it as a plenary address in March that year at the 6th CTI-Accounting, Finance and Management Conference in Glasgow.

I submitted the paper to a leading UK accounting research journal and one that, according to its declared interests, ought to have at least sent it out for review. Less than a week later, I received a note from the editor saying that, while he had found it extremely interesting and would certainly be making use of what it contained, he saw no benefit in considering it for publication in his journal. It seemed that some information was too useful to publish!

Knowing that it would only be a matter of time before someone else would publish a paper which made similar points to those I was making, I decided to maximise the potential readership of the paper by submitting it to the (far lower status) journal of the Computers in Teaching Initiative, *Active Learning*, where it was published three months later (Output 6). Such was the interest in this publication that I was invited to present a 3-hour public lecture in Singapore in February 2006. Over 200 Singapore businessmen, accountants, and academics attended the lecture. In the years immediately following publication of Output 6, I met many people at conferences who had read it and said that they had, as a result, decided to look at the web as a teaching resource. These included educationalists, economics, and information system academics as well as those working in accounting and finance.

Even today, some 13 years later, the concept of the “library on your desktop” which I introduced in that paper still amazes me: *“The World Wide Web represents a new concept in technology, the library on your desktop, the dictionary at your fingertips, the sound at your ear. There is nothing that we hear or see that will not be available through the World Wide Web.”* (p. 3)

Teaching and desk-based and library-based research nowadays is so different from 1995, yet much of what has transpired was foreseen or implied in that article.

Twelve years later, in 2007, I began to notice another dimension to this phenomenon of the library on your desk: it is an enormous but largely unorganised and poorly indexed resource, which means that you can perform a “full” search one day, spend weeks pursuing answers to your research questions, then redo the “full” search using

slightly different criteria and discover published work that makes what you have just spend weeks perfecting redundant! Conducting *original* research is far more difficult now than it was in 1995 *because it is now far easier to find evidence that it is not original*. With students now accustomed to using the Internet to find information for their essays, projects, dissertations, and theses, it is also far more difficult for academics to assess student work.

Many academics have yet to realise just how difficult reliable assessment of work of this type has become, though their growing awareness of the results of the use of plagiarism detection software such as *Turn-it-in* will probably lead to this becoming a significant problem over the next few years both for students and for those who assess their work. It is possible that the indexing capabilities and algorithms of Internet search engines can be improved sufficiently so that one day they are as efficient as a library catalogue index from the 1980s.

Alternatively, perhaps the only thing that has happened is that information that would previously have been hard for students to find is now readily available and there is so much of it that it is noticeably more difficult to ensure originality in research questions and research findings, completeness of the search of available databases, or the quality of the information obtained. It has always been the case that students could plagiarise, it just was not so easy to do as it is now.

Returning to integrating *World Wide Web* into my teaching, in 1995/6, I integrated a website prepared by Carol E. Brown at Oregon State University (OSU) into my compulsory level 3 module on accounting systems. This was possibly the first such example of transatlantic co-operation: it was certainly the first in accounting education. We maintained the site and kept it up-to-date and students used it as one of their two principal texts during the module.

The web was used both to supplant traditional lecture-based teaching and as the vehicle for thirty per cent of the summative assessment on the module. Email was used for communication with the students, for submission to the tutors of their Web assignment and for feedback to the students on the assignment. The students were

not enthusiastic about the OSU website but were extremely positive about the rest of the course.

Only 15 per cent of the students had explored the web previously and more than 80 per cent had never seen a website before the module started. None had ever created a webpage. By the end of the 12-week module, all the students had created their own websites and over 50 per cent had used the web as a resource for other modules. I had expected students to be positive about the module, but not as much as they were. It surely represented an innovation which other educators needed to know about. Consequently, within two months of the end of the module, I wrote and submitted Output 7 to *Accounting Education, an international journal*.

In July 1996, I moved to Queen's University, Belfast and took the integration of the web into an accounting systems module one step further than I had done at Aberdeen University. The students on my accounting systems level 3 elective were required to prepare their own websites for an existing small business of their choice. They had to obtain information from the owner and permission to create the website. The external examiner was highly complimentary of the innovatory nature of the project and of the pedagogical benefits it offered, making the point vociferously in the exam board. In 1997, I received an award for that innovation from the Institute of Chartered Accountants in Ireland (ICAI).

In that first academic year at Belfast, my accounting systems module was one which students typically took as a last resort. Very few were actually interested in the topic and many were among the weaker students in their year. Despite this, the student feedback rating at the end of the module was among the highest in the department. In 1997/8, student numbers on the module increased substantially from around 20 to almost 40 – perhaps as many as two-thirds of the honours cohort. The academic quality of the students also changed: that year it was a module which the best students elected to take. I never wrote-up my experiences on that module. That was probably a mistake but, by the time I thought to do so, I had moved on to the Open University and my access to the student work from 1996/7 and 1997/8 was lost.

However, I felt I was now achieving my goal of encouraging students to “learn how to learn”. Position Statement Number One of the Accounting Education Change Commission (AECC) published by the American Accounting Association in 1990 contains the following concerning learning to learn and it was reading this document in early 1991 that had ultimately driven me towards the innovations I introduced in these accounting systems modules (p. 4):

“Learning is often defined and measured in terms of knowledge of facts, concepts, or principles. This “transfer of knowledge” approach to education has been the traditional focus of accounting education. One goal of the Accounting Education Change Commission is to change the educational focus from knowledge acquisition to “learning to learn,” that is, developing in students the motivation and capacity to continue to learn outside the formal educational environment. Learning to learn involves developing skills and strategies that help one learn more effectively and to use these effective learning strategies to continue to learn throughout his or her lifetime.

“Academic programs focused on teaching students how to learn must address three issues: 1) content, 2) process, and 3) attitudes.

*“The **content** of the program must create a base upon which continued learning can be built. Developing both an understanding of underlying concepts and principles and the ability to apply and adapt those concepts and principles in a variety of contexts and circumstances are essential to life-long learning. A focus on memorization of rules and regulations is contrary to the goal of learning to learn.*

*“The **process** of learning should focus on developing the ability to identify problems and opportunities, search out the desired information, analyze and interpret the information, and reach a well reasoned conclusion. Understanding the process of inquiry in an unstructured environment is an important part of learning to learn.*

*“Above all, an **attitude** of continual inquiry and life-long learning is essential for learning to learn. An attitude of accepting, even thriving on, uncertainty and unstructured situations should be fostered. An attitude of seeking continual improvement, both of self and the profession, will lead to life-long learning.”*

I felt that I had certainly reached a point in these accounting systems modules at Aberdeen and Belfast where I was addressing all three of the issues identified by the AECC. For example, the learning objectives of these modules included:

- to instil a philosophy of continual learning;

- to develop an awareness of how to learn and how to adapt to or lead change;
- to develop an ability to seek-out information from whatever source(s) may be appropriate and to do so in a timely and effective manner;
- to develop the ability to collate and present information effectively in a useful form.

The subject area of accounting systems made what I did easier than it may have been with other modules: it was easy to make the syllabus topical and up-to-date and to sell the idea to the students that what they were learning in the module would be helpful in their careers. However, what they learnt in the rest of those two accounting systems modules was by no means easy.

Their textbook was by far the most complex on the topic that I have ever used, but at the same time, it was the most up-to-date and relevant to their future careers that I have ever seen (*Accounting, Information Technology, and Business Solutions* by Hollander et al., 1996). I had expected considerable backlash from the difficulty in the abstract, events modelling concepts and techniques in the textbook that they were being asked to grasp, understand, and apply but, in neither university did I ever experience any complaints from the students about either the intensity of study I was expecting of them or about the textbook.

Looking back at that point, I could see how I had reached this level of innovation and proximity to addressing the Accounting Education Change Commission's three issues. I started by introducing expert system technology into an accounting standards module at Strathclyde. I then looked at guiding student learning through the use of supplantive CBI and then through assessment. I gave students freedom to express themselves and find things out for themselves by having them write and present reports on demo versions of software and to learn how to use financial modelling software to prepare financial reports (in a level 3 module entitled *Information Systems and Decision Making* between 1989/90 and 1993/4). I also asked students to write expert systems and discuss case studies of expert systems in accounting (on a level 3 elective module entitled *Expert Systems in Accounting* during 1989/90 through 1995/6).

When the *World Wide Web* was made available on campus, it seemed natural to integrate it into the accounting systems module along with the other innovations I had found to work in these other modules. Perhaps it was serendipity, perhaps I unconsciously realised it ought to work: whichever it was, it did.

Concurrently with teaching the accounting systems module in Belfast in 1996/7, I was investigating how the web was being used in education globally and wrote Output 8. In it I outlined the various ways the web was being integrated into courses and, in some cases, was being used to deliver entire courses online. It was very much a “here is the state of the art” paper and one I hoped would encourage colleagues to experiment for themselves in how to use the technology to improve the learning experiences of their students. My description of this experience of undertaking Internet-based research when the web as an educational and research medium was in its infancy was published in 2004 as part of a refereed chapter in a book on undertaking qualitative research (Output 9).

In 1997/8, following on from the successful outcomes I had experienced previously using computer based instruction for both accounting standards and double entry bookkeeping, I decided to base my entire 12-week level one accounting for non-accounting students module upon two computer-based instruction packages: EQL’s *Understand Financial Accounting* and *Understand Management Accounting*. Instead of 36 lectures and 12 tutorials, students received 3 lectures (one in week 1 when they received an overview of management accounting; one in week 7 when they received an overview of financial accounting; and one in week 12 when the key issues covered in the module were summarised) and 45 computer lab sessions. Apart from the three weeks when the students had a lecture and three computer labs in the week, they had four hours of computer labs every week (each on a different day).

In each lab, they worked through specified chapters in one of the two CBI packages and, every Friday, the tutorial started with a ten minute computerised summative 20-question Objective Test using *QuestionMark* based on the material they had studied that week. Students had to achieve an overall average of 40 per cent across the tests in order to be allowed to sit the exam.

Of the circa 200 students, seven did not achieve this standard. They were then given a week in which they could retake the final test as often as they wished in my office under my supervision. All succeeded in the end. Only one student failed the written examination. In the previous year, I had taught the module conventionally and the pass rate had been approximately 70 per cent.

However, when I looked in more detail at their exam performance in 1997/8, I found that in contrast to my experience in using the *PEER Accounting Standards* package, use of these CBI products had only resulted in surface learning.

The students performed very poorly at the essay questions in the examination but exceptionally well on the rest of the paper, which comprised of objective tests questions similar to those they had answered in the tutorials, hence the high pass rate.

In response, in 1998/9 I reintroduced some lectures and reduced their time in the computer labs accordingly, but I left to join the Open University before I could complete my analysis of the results.

With hindsight, I should have written-up and published my finding from 1997/8. It was important in the context of the increase in the adoption of CBI both in accounting departments and in the profession that was evident at that time: EQL and others had started to increase the range of materials on offer and CCAB members were adopting it as well as universities. However, I did secure a publication from this work.

The significant success I had in raising the pass rate on the last module described above by using CBI was not missed by colleagues and awareness of my previous work on the use of CBI while at Aberdeen led two of them to integrate computer based instruction into their level 3 taxation course (McCourt-Larres and Radcliffe, 2000) and another to introduce summative objective tests into her level 3 marketing module in 1998/9 (Sangster and Maclaran, 2000). I helped my accounting colleagues design their tax module but the actual implementation was their own.

In the case of my marketing colleague, I worked with her in 1998/9 on the summative objective test assessments and was present with her during all the tests. During the module, the number of objective tests was increased from two to three after we had problems with the first test, negative marking was introduced and then dropped, the

students were tested in groups on different days for the first test and then moved into smaller groups and all tested on the same day for the other two tests; and the attitude of the students shifted from being unconvinced by the fairness of the innovation to embracing it.

The key findings of this research were that it demonstrated that objective tests could be used effectively in higher level modules rather than, as many perceive, solely at lower levels; and that students have to be prepared properly for their first exposure to summative computerised objective tests.

[I had always done the latter and we implemented the same level of pre-assessment training as I had done in the past. However, my earlier work was with lower level students for whom the marks would not affect their honours grades. In this case, the assessments did affect their honours grades and the students were apparently considerably more apprehensive than those with whom I had used objective tests previously.]

Another aspect of the implementation followed from the focus we adopted in the summative objective tests upon underlying knowledge and understanding along with some questions on application. This allowed my colleague to be far more “adventurous” in the final written examination than previously, with the final written examination taking a more contextual and holistic approach than would otherwise have been appropriate. It comprised of two compulsory questions: one involved constructing a mini case study to illustrate a marketing-orientated company; and the other was an essay (echoing my accounting systems module project at Aberdeen University) that required students to discuss how the Internet could be used in the marketing strategy of a firm.

Thus, all assessment of knowledge and understanding of the various theories and principles covered in the course was dealt with in the summative objective tests. This represented a massive shift in the style and content of the final examination compared to previous years, and it appeared to have been a successful innovation: the overall performance of the students that year was virtually the same as in the previous year (a mean of 62.6 per cent compared to 61.9 per cent). Another finding in that study was

that the students felt that the inclusion of summative objective tests had been helpful (as they perceived that it guided their learning) and felt that it was an appropriate way to examine the topics and concepts covered in the summative tests.

This was something I took with me in 1999 when I moved to the Open University with the remit of creating a new state-of-the-art one year part-time 60-credit accounting course that would gain successful students exemption to all the level one examinations of ACCA, CIMA and CIPFA.

I used summative continuous assessment in the new course to guide learning, and it appeared to work. However, I was beginning to sense that it was time to call a halt to research in this area, a view that was to be reinforced after I published Output 10 in 2005, a paper about my experiences in developing and running the course, *The Certificate in Accounting*.

Once the course was developed, most of our problems were with the software we used for the objective tests. However, being allowed to use that software was a major battle as it was considered in the university that simpler in-house software was all we needed. I also wanted a shorter window for students to take the objective tests. They had two weeks to attempt each of six tests, which I felt was too long. However, I could not overcome the university view and had to accept a 2-week window. This meant that students could start the test when the window opened, note down a question and then log out of the assessment system. They could then look for the answer in their course materials, then log back into the test to answer the question and carry on this way, ensuring that they finished the test before the window closed. (They had a 2-hour time limit for each test once they started it, but this related to the time they spent actually answering questions, not the time between starting and finishing a test.)

I believed that the constraints imposed by the university's established norms had to be broken in order to make the course viable and I needed all my teaching and learning experience to force through the innovations which I believed to be critical. I had to fight for permission to have so much assessment in the course; and the use of online objective testing rather than paper-based testing was also a difficult thing to get

accepted. I also had to fight for the use of the EQL CBI CDs integrated into conventional books rather than simply conventional books.³

Bizarrely, the one thing I completely failed to get that I had considered to be essential was the one thing I had always assumed I would have: residential revision schools before the examinations. This more than anything left me surprised when I calculated the overall pass rate (which was much higher than I had expected) and realised that we had not only successfully guided student learning through the assessment, we had also kept the students enthusiastic enough to make them successful independent learners.

Student feedback on the course was very positive. As also happened on the marketing module at Queen's, many students made the point in their responses to the end of course questionnaire that they were grateful for the way in which the objective tests had paced them through the course material.

It was a very successful project and, in the end, it fulfilled my hopes and justified all the work it took, but it also left me wondering what to do next.

This work at the Open University represented a break-point in my research. I had moved from a pedagogical interest in a specific form of information technology – expert systems – to an interest in computer-based instruction, and then to a detailed analysis of how the internet and, in particular, *World Wide Web* could be utilised in order to enhance student learning and encourage students to “learn how to learn”, to become independent learners. Meantime, I had looked at computer-based assessment at the lower, the middle, and the final level of undergraduate degrees, and had looked at the relevance of student learning styles to the form of student assessment. I had then taken all the knowledge and expertise I had acquired and applied it to design and write the instruction and assessment material for the Open University *Certificate in Accounting*.

³ The use of CDs and online objective testing was considered unfair within the university as not all the students would have laptops so they would be unable to do their studying when they wanted (e.g. on a train) and they would not all be able to do the objective tests as they might only have access to computers that were behind firewalls.

While the course had been very successful, our attempts to encourage others to look at what we had done appeared to fall on deaf ears. Within the university, even within my department, our use of objective testing was generally considered inappropriate and no-one seemed willing to look at the pass rates we had achieved and the findings of our research into those pass rates, nor at the level of student satisfaction.

Outside the university, it was even worse. Sally Aisbitt (my principal colleague at the Open University) and I presented an early draft of Output 10 to a large national conference specialising on computer-based assessment but had no response to our offer to circulate copies of a more detailed version of our work and findings, nor to our offer to share our experiences in more detail with anyone who wished to contact us. We had also been rejected for a teaching award from the American Accounting Association by a referee and committee chair who never looked at our online material, as they “did not consider it relevant to [our] claim of innovatory practice.”

Another factor that led me away from that line of research came from the resistance I had consistently experienced to innovation. This did not come from students, but from colleagues, both academics and administrators. It seemed to be never ending and, at the Open University, it reached a peak that seemed to suggest that another focus to my research might be more productive.

It was difficult to see what else I could achieve in this line of research other than to continue to promote the findings of my studies and encourage others to embrace these technologies in a pedagogically effective way. I had and have always done this in my role as an external examiner and mentor to colleagues. However, I have ceased to include the integration of technology in education as part of my research agenda.

I decided that if findings from blue skies research were not something that colleagues were likely to listen to, perhaps looking in muddy waters might be more acceptable. Perhaps there was something accounting educators could use from the past that could improve the student learning experience, encourage engagement and stimulate learning. If I could not convince others concerning the merits of using technology to improve student learning and to encourage their students to “learn how to learn”,

perhaps they would be more inclined to introduce relevant historical material into their syllabuses and modules.

History can be used to demonstrate the relevance of topics and to encourage students to engage with topics they otherwise find mechanistic and uninteresting, such as double entry bookkeeping. Accounting history was one of the five principal subjects of the curriculum proposed by five US University Presidents in 1903 (Cleveland, 1904) at a time when accounting was not a university subject anywhere else other than in Italy.

As I will discuss further later in this thesis, calls for the inclusion of history in the accounting curriculum have been repeated many times since then. By using history in this way, students might engage better with those topics and learn them better. At the same time, it could help them “learn how to learn” by making them realise that sometimes looking beyond the mechanics of a topic and instead looking at it from a social science perspective – how it fits into the world around them and how it is of importance to that world, however defined – might increase their understanding of that topic.

History has the advantage for educators that it does not carry the often perceived risks inherent in any implementation of information technology and so may be more acceptable than IT as something to integrate into teaching. Consequently, I switched to looking at how accounting history and, in particular, the first known printed treatise on double entry bookkeeping written by Luca Pacioli in 1494 might be integrated into the accounting curriculum. This resulted in the publication of Output 11.

I was driven in this direction at the behest of Sally Aisbitt. She shared my views on the importance of double entry bookkeeping and my interest in assessment, but she did not have the time in her schedule to get involved in investigating its origins. However, we shared an administrative colleague at the Open University, Pat McCarthy, who is an art historian in her spare time and who had become intrigued by Luca Pacioli because of a portrait of him which is currently located in Naples. (There is a lot of controversy about this painting and it has featured on a great many book covers across a wide range of disciplines.)

Pat was intrigued that I had insisted on placing it on the cover of all the 16 books of the Certificate in Accounting and felt that if Pacioli was so important in the history of accounting that I was willing to fight my way through all the (considerable) red tape at the Open University in order to use it, we ought to find out more about him and the origins of the techniques he handed down to us in his treatise.

I had left the Open University by the time Pat found time to travel to Italy and discover something of the geography of Pacioli's life but when she returned she prepared a paper expressing her views about Pacioli and his life and works. She asked Sally if she would be interested in working with her to create a publishable article, and Sally asked me if I would be willing to do it in her place. As it was already an area I planned to research, I accepted Pat's invitation and started working with her.

We presented a preliminary paper at an education conference in Bordeaux in November 2005 and I then started working on Pacioli from the bottom-up. I started by discarding all the content of that paper but retained some of the source material Pat had unearthed. About three months later, I invited Greg Stoner, a lecturer at Glasgow University to join us in this project and so it proceeded, with me leading the research and the writing. Greg, whose main role was commenting on what I wrote, also added some additional material. Pat acted as a sounding board for our ideas and offered some of her own. It has been a successful team effort resulting in three papers, one of which is included in this thesis as Output 11 plus McCarthy et al., 2008 and Sangster et al., 2008. Meantime, I have undertaken solo research into Pacioli's life, the printing of his treatise, and how we might use it today (Sangster, 2007 and 2008).

Output 11 and these other works represent a marked shift in the type of paper I am preparing in pursuit of my goal of increasing the capability of students to learn how to learn, to become lifelong learners. I am now looking at:

- making our teaching more approachable and more customised to the knowledge, or lack of it, of our students; and,
- making students less acceptable of facts delivered out of context or without some basis for their validity.

At the same time, I continue to:

- encourage students to want to learn what we are trying to ask them to learn;
- show students how to learn and guiding them in their learning; and,
- inculcate in students the desire to keep an enquiring mind throughout the rest of their lives.

These are the types of changes I would like to think I have brought about in some of my students and which I hope others have achieved and will achieve as a result of reading about some of the things I have done or which I suggest they should try, things that will help their students “learn how to learn” and to become lifelong learners.

3. The Published Outputs

The eleven papers included in this thesis all relate to the theme of encouraging students “to learn how to learn”. However, there are some sub-themes within which they may be classified:

1. The use of IT in teaching and learning

(a) In general: Output 1

(b) Computer-based instruction: Outputs 2, 3, and 4

(c) Computer-based assessment: Outputs 5 and 10

(d) The Internet and *World Wide Web*: Outputs 6, 7, 8, 9, and 10

2. Using accounting history to increasing the relevance of material to students: Output 11

3.1 The use of IT in teaching and learning

3.1.1(a) *In general*

Output 1

Knowledge Based Learning within the Accounting Curriculum, The British Accounting Review, Vol. 23, No. 3, September 1991, pp. 243-61. (with Alan Wilson) [50%]

Motivation

In October 1987, I moved to Strathclyde University. I had completed an MSc in Operational Research in 1986 by part-time study over two years, including a dissertation. My dissertation was on expert systems (computer programmes that emulate the conclusions of experts) and included an expert system I had developed on elementary bidding strategies for the game of bridge. That expert system was written using a software program called *Crystal*, a product which was available free to all universities and central institutions in Scotland at that time.

While I was writing my expert system, I was struck by how doing so clarified some issues I had previously found difficult to grasp. Then, in 1988/9, I was asked to teach a second level financial accounting module that involved students studying a range of accounting standards of which I was told they generally struggled to understand the

more complex elements. Recalling my experience when building my expert system, I speculated whether asking them to write expert systems for some of the standards might help them in the same way my own expert system had helped improved my understanding of the bidding rules of bridge.

This led me to conduct an experiment whereby the students were split into three groups. One group's tutorials were located in a computer lab where they used *Crystal* to prepare expert systems for three accounting standards. *Crystal* was a rule-based (i.e. "if-then-else") environment for building expert systems, so it seemed sensible to guide the students in how to build their expert systems by asking them to prepare flowcharts of the rules of the standards before the tutorial, which they then used during the tutorials to construct their expert systems. In addition, their textbook had flowcharts for some aspects of each accounting standard (Blake, 1988), so asking them to prepare flowcharts seemed a sensible thing to do.

I did not undertake any review of the literature prior to undertaking the innovation. I had no idea how to conduct research at that point. In the paper we published, it was my co-author who conducted the literature review and I was guided by him in the need for control groups and in the statistical tests to run on the data I collected. We did not find any example in the literature of the form of pedagogical use of expert systems adopted in this innovation, nor of our use of flowcharts. Both were original concepts.

The innovation

Over the course of the module, the students in the expert systems group prepared expert systems and then used them to answer 70 short mini-case scenario questions requiring application of accounting standards. For example, "how should you treat research expenditure incurred in investigating whether or not it was possible to develop a means for people who squeeze too much toothpaste out of a tube to put back the excess into the tube for later use?" The second group was asked to prepare flowcharts for each tutorial and then use them to answer the same questions. The third group was asked to prepare for the tutorials by learning about the standards and

then spent the tutorial time answering the same set of questions as the other two groups.

The findings

- In both the tutorial tests and in the essay part of the end of module exam, the expert system group consistently outperformed the flowchart group which consistently outperformed the traditional group.
- There was no significant difference between the three groups in the short-question part of the final exam (which comprised of 30 questions similar to those they had answered during the tutorials), though the flowchart group did outperform the other two groups on these questions.
- Overall, no statistically significant difference was found between the performance of the expert system group and the flowchart group but a significantly better (at the 99 per cent level) overall performance was found for the expert system group and the flowchart group compared with the traditional group.

Summary

I had already used video both to teach and to assess students (while at Queen's College). I had also used spreadsheets in an examination (also at Queen's College) and, at Strathclyde, I had taught students in a series of computer labs how to use a database package and a general ledger accounting package. At Strathclyde, I was also involved in MBA teaching and had used a computer simulation involving email interaction with students playing the role of company directors while I played the role of all the employees, suppliers, customers, Government agencies, and other external entities.

This sub-theme of research contains only one output but it gave me additional confidence to use information technology as a pedagogic device and to do so unaided – all my experiences of using technology in teaching prior to the innovation in Output 1 had been led by someone else.

It also taught me the difference between writing about innovation as a journalist, which I had done while at Queen's College (Sangster, 1986) and doing so for a refereed

academic journal. Thereafter, I spent many years looking for technology I could use in my teaching, but always technology that I felt enhanced learning rather than technology that made teaching easier, such as PowerPoint and White Boards. While I have used these teaching aids, they neither proactively or implicitly guide nor enfranchise learning and it is this that I continued to seek following my move from Strathclyde to Aberdeen University in 1989.

3.1.1(b) Computer-based instruction: Outputs 2, 3, and 4.

Output 2

Computer-Based Instruction in Intermediate Accountancy Courses, In the proceedings of The Integration of Computer Based Training Materials in Higher Education Conference, Bradford University, December 1991, Holmes, G. (ed.) *Integrating Learning Technology in the Curriculum*, CTISS, 1992, pp. 44-8.

Motivation

At Strathclyde I had learnt why it is necessary to undertake a literature review when conducting research. I had decided that I would like to conduct research on CBI over more than one academic year and I decided to undertake a large scale review of the relevant literature to support all the work and innovation I might undertake over the following years. This decision was partly motivated by a perceivable pressure on academics to increase teaching loads: student numbers were forecast to rise by 30 per cent over the decade and the Government was funding various initiatives aimed at increasing use of IT in teaching, which I interpreted as suggesting that we would be expected to replace some of our face-to-face teaching with CBI. In addition, UK professional accountancy bodies were actively promoting use of CBI packages in accounting education.

During 1991, I spent nearly five months gathering, reading and summarising over 200 education papers on the use of IT in teaching. I then presented a selected summary of the literature at the Integration of Computer Based Training Materials in Higher Education Conference in December 1991. This was the first paper I ever formally presented in a conference. It was never published, other than in the proceedings of

the conference, but it underpinned much of the research I did during the following nine years.

The findings

Overall, the paper reported a paucity of literature concerning supplantive use of CBI. It was the first such study and, effectively, painted a very bleak picture for anyone considering supplantive use of CBI:

- Computer-based instruction had been in use in accounting education since the 1960s.
- It was only being used at levels one and two, not at level three.
- Supportive use of CBI was reported as either having no impact on student performance or as having had a positive impact.
- Only one example was found in the accounting literature of supplantive use of CBI and that dated from 1976.
- Only two examples were found in the literature where the CBI package was purchased from a 3rd party; all other examples of CBI were developed in-house. The two examples found dated from 1976 and 1981.
- Very little was known about the benefits or otherwise of using CBI supplantively.
- Very little was known about how to integrate supplantive CBI into courses.
- The paper recommended that anyone seeking to use CBI supplantively should adopt an experimental design in order to discover how successful the implementation had been.

Output 3

Computer-Based Instruction in Accounting Education, Accounting Education, an international journal, Vol. 1, No. 1, 1992, pp. 13-32.

Motivation

As mentioned earlier, in 1990 my department purchased a site licence for the computer-based instruction (CBI) package: *PEER Accounting Standards (PEER)*, to use on a level two financial accounting module. The motivation for the innovation was purely “because it was there”. As with Output 1, I conducted no literature review before designing the innovation. I worked through the package to assess whether it was of a good standard and quality, in terms of its interface, facilities, and content. Then, having convinced myself that I could trust it to instruct students, I redesigned the module with the aim of discovering whether *PEER* could be used in place of a human instructor. When I subsequently conducted the literature review that resulted in Output 2, I found no reason to adjust the design of the module.

The innovation

In 1990/1, I introduced *PEER* into my level two half-module on accounting standards and added four standards to the syllabus (making nine in total). Five accounting standards had previously been taught in 12 lectures and three tutorials. In 1990/1, delivery was changed to nine lectures and six computer labs. In the computer labs, students had to study the four additional standards using *PEER*. They received no other instruction on those topics, though I was present during their scheduled computer labs in order to address any problems they had in using *PEER*.

However, after the first two weeks, I went to the labs only long enough to take a register of attendance and check that no-one had a problem getting started and then left. Students could phone me in my office from the lab if they needed help but I was never called.

In the paper, I describe this as “supplative” use of CBI because the package replaced the lecturer on those four standards. They could study the other five standards using *PEER* if they wished, but instruction in them was provided through the nine lectures. I

describe this as “supportive” use of CBI because *PEER* was an ‘extra’ resource for these five standards, one that students could use in addition to what they learnt from the lecturer.

Use of the material on the four additional standards was integrated into the module: the students were constantly reminded in the lectures of the stage they ought to have reached in their CBI learning, and questions were set on the *PEER*-taught standards as well as on the lecture-taught standards in their mid-module class test and in their examination. The students were also often encouraged and reminded to use the formative assessment in the *PEER* package to monitor their own progress. They were also asked to complete questionnaires at the beginning, middle and end of the module which focused on their computer abilities and their use of *PEER*.

The findings

- In their examination, students performed no better and no worse on the four standards taught solely using *PEER* than they did on the five taught in lectures; but,
- no evidence was found that their performance improved on the five lecture-taught standards when they may also have used *PEER* but were not required to do so.
- Thus, it appeared that supplantive use of computer-based instruction (i.e. learning from CBI instead of from a human instructor) was an appropriate approach for this topic, but that supportive use of CBI (i.e. use of CBI as an additional learning resource in the same way as recommended reading is an additional learning resource) made little difference to their learning of this topic.

The literature review described under Output 2 gave me confidence that what I was attempting was appropriate and that if I had successfully integrated use of *PEER* into the module a positive outcome should result. Finding that this appeared to be the case marked something of a watershed in my understanding of the benefits of CBI and Output 3 is my 4th highest cited output according to Google Advanced Scholar (with 21 citations, the most recent being two citations in 2006).

Output 4

EQL Bookkeeping – the demise of the lecturer?, In the selected proceedings from the 3rd Annual CTI-AFM Conference, Bradford, April 1992, Williams, B.C. and Nicholson, A.H.S. (eds.), pp. 31-40. (with David Rawlinson) [30%]

Motivation

In 1991, a colleague decided he would like to try using the *EQL Bookkeeping* package with his first year financial accounting students. He knew what I had done with *PEER* and he wanted to discover if the recently released *EQL Bookkeeping* package could also be used supplantively. From my review of the literature (Output 2) and from what I had found in my use of *PEER* (Output 3), plus the quality we perceived in the *EQL Bookkeeping* package, it seemed likely we would be successful so long as we guided the students in their learning.

The innovation

The package was used alongside lectures and workshops on double entry. The module was taught over a 20-week period and the class was split into two groups:

- (a) Those who had studied double entry before starting at university (the experienced group)

This group had one optional 1-hour lecture a week and one compulsory 1-hour EQL lab. For this group, EQL replaced a series of tutorial workshops which had been compulsory in the previous year.

- (b) Those who had not previously studied bookkeeping (the beginner group)

This group received one compulsory 1-hour lecture and one compulsory workshop each week. They could also attend the same 1-hour EQL labs as the experienced group.

We worked together on how to organise the classes and prepared a schedule for the students to work to. We showed them how to use the package and stayed during their timetabled computer labs in order to deal with any problems that might arise in use of the software. Initially we stayed in the lab throughout the period but we later adopted

the same approach as I had used in the *PEER* labs and retreated to our offices after dealing with any initial problems the students had. At the end of the module, the students sat a one-hour paper-based multiple choice exam. The beginner group used *EQL* supportively but the experienced group used it supplantively.

The findings

Despite *EQL* being optional for the beginner group, their lab attendance was 91% compared with 97% for the experienced group: effectively, the beginner group treated use of *EQL* as compulsory. The beginner group spent an average of 11.65 hours using *EQL* compared with 11.15 hours by the experienced group. The experienced students attended an average of 3.6% of the workshops compared with the beginner group's 87.5% attendance. The experienced group attended 5% of the lectures compared with 20% in the previous year.

Student performance in the final 1-hour 25 question paper-based multiple choice examination was 67.3% for the experienced group compared with 59.1% for the beginner group. However, compared with the previous year, the experienced group pass rate rose from 93% to 94%; and the beginner group's pass rate rose from 65% to 100%. It appeared that by using *EQL* the beginner group had reinforced their learning.

Supplantive use of *EQL* by the experienced group had resulted in the same level of performance as in the past when *EQL* was not used. Supportive use of *EQL* had resulted in increased performance for the beginner group. However, they had been timetabled to use it and, because the experienced group were required to attend the labs, so did the beginners. In effect, supportive use of *EQL* by the beginner group had been integrated into the course. For them, *EQL* was more than simply an additional resource – the equivalent of another textbook in the library – it was an additional resource they believed they needed to use.

Another finding (which reinforced what we had found in previous years) was that prior study of double entry resulted in better performance in the year-end assessment. By using *EQL*, in terms of pass-versus-fail, we had narrowed, though not eliminated that differential. For anyone who had studied double entry previously, *EQL* appeared sufficient for them not only to maintain the standard they had previously reached, but

to improve it: in a pre-course test, only 50% of the experienced students had achieved a pass but 94% had passed the end of course examination (compared with 54% and 93% respectively the previous year). It appeared that “*EQL* could safely be substituted for lectures.”

Summary

This sub-theme of research laid the foundation for what I attempted next. I was confident that I could use CBI effectively and that, compared to lectures, integrated use of CBI added value to student learning:

- students could learn more in the same number of timetabled hours;
- the change in form of delivery inserted some variety into their learning; and,
- (from both analysis of their completed feedback questionnaires and from observation and conversation) many students liked having the control over their learning that use of these packages gave them. For example, when taking notes from *PEER* or from *EQL*, they could page forward and back and check they had not missed anything and they could make sure that what they wrote in their notes was accurate and correct. Lectures do not offer this type of support.

3.1.1(c) Computer-based assessment: Outputs 5 and 10.

Output 5

Objective tests, learning to learn, and learning styles, Accounting Education, an international journal, Vol. 5, No. 2, 1996, pp. 131-46.

Motivation

On the basis of what I had learnt from my first use of *PEER* in 1990/1, I increased the amount of supplantive CBI in the accounting standards module in 1991/2 by adding a 10th standard to the syllabus.

I also introduced computerised formative objective tests using the *QuestionMark* package. This was motivated by a sequence of events:

- in 1991, I had refereed a paper by Tim Fogarty and Paul Goldwater (1992) which looked at how students might be assessed using an intelligent form of computerised objective testing;
- this made me interested in exploring how I might bring multiple choice tests into my teaching so as to guide student learning and that led me to attend a training course run by the ICAEW on how to write multiple choice questions;
- upon my return from the course, I started having some discussions with a colleague at Aberdeen, John Cruikshank, who had some experience of and some old handbooks on how to write multiple choice questions.

During those discussions, I began to realise that it was not multiple choice tests I ought to use but objective tests – they are a much more active form of assessment because students need to know how to obtain the answer and cannot easily guess correctly what it is. It was from those discussions that I formulated how I would integrate objective tests into the accounting standards module. I did not conduct any literature review before doing so.

Once I had confirmed to myself that the introduction of computerised formative objective tests in 1991/2 had aided student learning, I thought it worthwhile trying to use *QuestionMark* to deliver part of their final examination. Objective test questions on accounting standards had been in the exam paper for some years previously but they were tedious to mark and the risk of students removing the paper from the exam hall was high and would have required that a new set of questions be written had it occurred. It was for these reasons that the objective test part of the final written examination became a computer-based summative objective test in 1992/3. The length of that assessment and subsequent changes to the rest of the assessment on the module were decided by colleagues or were the result of pressure from the university's Computing Centre.

The innovation

In 1991/2, students used *PEER* to self-instruct themselves on a series of accounting standards and then sat computerised objective tests of between 25 and 40 questions

each. Each test lasted 10 minutes. The rest of the hour was spent working with students in a tutorial in which they discussed questions from my textbook (*Workbook of Accounting Standards*) on the standard upon which they had just finished a test.

These objective tests were formative: they made no contribution to the overall assessment mark for the module. However, in order to be allowed to sit the end of module examination, a student had to achieve an overall average of 50 per cent and a minimum of 40 per cent in each test (and could retake them as often as necessary in order to do achieve the 40 per cent mark). Once all the students had achieved 40 per cent on a test, it was made available to the entire class for revision.

I monitored attendance at all the tutorials and used registered mail to contact all students who missed one – email was not in general use in the university at that time, and nor were computers – reminding them that they had to attempt and pass the objective tests they had missed and that they would need to see me in order to do so. (The tests and test results were stored on floppy discs which I kept in my office – one disc per student.) This caused me a lot of inconvenience in the first few weeks of the module. However, students soon realised that it was better to attend the tutorials. The alternative was to try to find me in order that I could walk with them to the computer lab and ensure they knew what they were doing (there was only one lab available to us at that time), do the assessment, and then return the floppy disc to me.

In 1992/3, three changes were made. The tests and each student's objective test answers and scores were stored on a file server instead of floppy discs; the objective test part of the final examination switched from being part of the paper-based examination to a separate computer-based summative objective test held a week after the last tutorial; and the requirement for a 50 per cent overall average was dropped and replaced with the requirement that students achieve a minimum of 40 per cent on each tutorial's objective test.

During 1992/3 and 1993/4 I also looked at the learning style preferences of the students. I did so, not because of anything I had read in the literature, but because a colleague suggested that doing so might help explain differences in performance on objective tests compared to written essays. As with these other innovations, I did not

conduct a literature review before doing so, but I did conduct one before I wrote about my experiences.

The findings (a) on assessment

When the requirement for a 50% overall average over the formative object tests was dropped in 1992/3, it appeared to have a significant impact upon the student performance in the last tutorial test. The first attempt mean average dropped from 61 per cent in 1991/2 to 39, 38, and 40 per cent over the next three years, and the first attempt pass rates dropped on that test from 99 per cent in 1991/2 to 46, 54, and 42 per cent in the following three years. Consequently, I concluded that:

- if you require students to achieve an overall percentage for a series of objective tests that is higher than the minimum pass level required for each objective test, the topic the students find most difficult should be the one tested in the final objective test. This is because they will, on average, work harder, and know and understand better the final topic than any of the others under an assessment rubric of this form.

Table 1 shows that the performance over the four years on the 21 final summative objective test questions (which were unchanged across this period) varied from year to year with the mean average percentage mark in each year, 1991/2 to 1994/5 being: 60, 71, 64, and 56. Pass rates (the pass mark was 40 per cent) on these questions were: 90, 100, 89, and 75. The written essay mean average percentages were: 52, 58, 52, and 38 and the pass rate percentages: 94, 93, 80, and 64.

Table 1: Final summative performance	1991/2	1992/3	1993/4	1994/5
Summative Objective Test mean %	60	71	64	56
Summative Objective Test pass rate %	90	100	89	75
Essay mean %	52	58	52	38
Essay pass rate %	94	93	80	64

The analysis I conducted across the four years found that:

- When summative assessments involving objective tests are computerised rather than paper-based, marking time is reduced and marking is more reliable, the

possibility of cheating is reduced and the assessment can easily be prevented from entering the public domain.

- Students who are accustomed to answering computerised objective tests prefer to undertake computerised assessments of this type rather than paper-based ones.
- Students who are accustomed to completing computerised objective tests will answer summative objective test questions far quicker if they are computerised than if they are paper-based.
- No evidence was found that changing the timing of formative objective tests within a tutorial from the beginning of the period to the end made a difference to student performance on the objective tests.
- Students will tend to adopt a surface approach to their learning for objective tests but a deeper approach for essay-based assessment and, because some are better at surface learning and others are better at deeper learning, the two sets of marks will not follow the same profile across the cohort – i.e. the rank order of students in each case will be different.

The findings (b) on learning styles

- Any reinforcement of learning resulting from objective tests may only be short-term.
- The absence of a developed learning style preference may have a negative impact upon performance in assessment.
- There may be a minimum threshold of learning style preference on the LSQ that must be achieved before any significant impact on performance is identifiable.
- Any move towards increasing the proportion that objective test questions represent of an overall summative assessment needs to recognise that individual learning styles may impact performance.
- Students should be encouraged to adjust their learning styles so as to adopt an approach to learning that is aligned with the form of assessment they will be undertaking.
- Students should be tutored in how to develop their learning style dimensions so as to be able to appropriately respond to the nature of their assessment.

- Learning styles could be relevant, if not crucial, to students being able to adjust their learning to match the requirements of their assessment and, more generally, to their being able to “learn how to learn”.
- More work is needed on learning styles.

Output 10

Using Internet-based On-line Assessment: A Case Study, Accounting Education, an international journal, Vol. 14, No. 4, 2005, pp. 383–94. (with Sally Aisbitt) [50%]

Motivation

At the Open University, I had to “squeeze a quart into a pint pot”. The 60 credit course could only last a year (part-time) and yet it had to contain everything required to obtain accreditation by ACCA and CIMA and, if possible, CIPFA. The approach I adopted to course design and assessment was based on what I had learnt through all the innovations I had attempted up to that point (1999).

For example, because of what I learnt in working on Output 4, double entry bookkeeping was excluded from the course and treated as a separate component that the students had to study before formal tuition started. My experience with CBI told me that we could accelerate learning by using CBI as an integrated component of the course (Outputs 3 and 5). It also told me that we could guide learning and reinforce it through an integrated programme of formative computerised objective tests (Output 5).

In addition, increasing the importance of the tests by making them summative would increase the possibility that students would benefit from them. I had also learnt (Output 5) that the subjects that students were likely to find most difficult – in this case, those that had the least direct relevance to accounting – should be assessed in the last of the six objective tests. Finally, following what I had learnt when working on continuous assessment in the level 3 marketing module at Queen’s University, Belfast (Sangster and Maclaran, 2000) most of the assessment of knowledge and understanding was done in the objective tests.

I looked for literature on distance learning innovation but found nothing that added to my knowledge and understanding. The innovation at the Open University was unique: a major blue skies project that sought to develop the learning skills of mature students ranging in age from 16 to over 70, most of whom had undertaken no formal study since they left school.

The innovation

I spent two years developing the new course, *The Certificate in Accounting*. In doing so, I integrated (customised) material from EQL's suite of computer-based instruction packages into 14 of the 16 (100+ page) books (i.e. units or components) of the course, including one book that comprised solely of EQL material on law and economics.

Half of the two years was spent using *QuestionMark Perception* to write 1,800 objective test questions covering the entire syllabus. These questions were put into three test banks. Each test bank comprised of six 100-question tests. The first bank was used for formative assessment (i.e. made available to the students to practice upon both prior to and after each summative assessment); the second was used for summative assessment with approximately 6-8 weeks between each test; and the third was held in reserve. All questions incorporated extensive feedback on both correct and incorrect responses and all the objective testing was delivered over the Internet and accessed by the students using a web browser such as *Internet Explorer*.

Students could take the tests at any time in a 2-week window and were given two hours to complete each test. They had to achieve an overall average of 40 per cent if they were to be able to pass the course. They also had six traditional summative assignments (i.e. essays and calculation and presentation questions, such as those involving preparation of a profit and loss account) and prepared their answers to these traditional questions using spreadsheets and word processor software and then uploaded them to the university file server. There were also three 3-hour written examinations at the end of the course.

The first cohort was over 550 students. An overall pass rate of almost 50 per cent was achieved of those who sat the three final examinations. This was approximately the

same pass rate as trainee accountants were achieving in their equivalent CCAB examinations.

Findings

- A strong correlation was found between performance on the objective tests and in the final examination, providing support for the view that without the objective tests, exam performance would have been significantly lower.
- (from their responses to an end-of-course questionnaire) Students perceived that the objective tests had paced them through the course material and were grateful that it had.
- Approximately two-thirds of the students did not use the objective tests for revision: they appeared to have assumed that those types of questions (knowledge, understanding and application) had been done in the tests and that they would not need to answer questions of that type in the written examination. (So far as I know, no-one had said this to them, though the sample examination papers they had been given implied this.)

Summary

This sub-theme of research ended at this point. I had investigated whether CBI and continuous assessment in the form of computerised objective tests could instruct effectively (CBI) and guide learning (OTs), and had found evidence suggesting that they could. I had then designed a complete 60 credit course around these premises and had found that not only could CBI direct and OTs guide learning but that students could become aware of how objective tests had helped them to organise their studies. To my mind, once students become conscious of how something helps them to learn, it marks a large step towards “learning how to learn”. Consequently, these innovations show that CBI can instruct effectively and that continuous assessment using computerised objective testing can promote lifelong learning.

3.1.1(d) The Internet and World Wide Web: Outputs 6, 7, 8, 9, and 10.

Output 6

World Wide Web – what can it do for education?, Active Learning, Vol. 1, No. 2, July, 1995, pp. 3-8.

Motivation

I had started to integrate the Internet and *World Wide Web* into my teaching and was using the web increasingly in my research since early 1994. The benefits that this new technology could bring to both education and to research seemed obvious to myself and others with similar experiences. However, few of my colleagues seemed willing to take the time to learn how to use this new technology and were, as a result, hard to convince of its potential. I had looked at what people were doing on the web but the technology was so new that there was nothing in the accounting literature about it. Accordingly, in early 1995, I decided to start bringing it to the attention of others and wrote Output 6, partly because I wanted to do be the first to do so.

Content

- How to find information on the web.
- A strategy to adopt in searching for information on the web in order to maximise the resources of interest found.
- An outline of the types of resources available on the web.
- Where to start looking for educational material on the web.
- A warning about the need to be careful in what you ask for when using an Internet Search Engine to trawl for resources on the web – failing to limit the number of items requested can lead to extensive delays and information overload when the results are presented.
- A warning about the hit-and-miss nature of using search engines.
- A recommendation that the web is used in order to encourage students to “learn how to learn”.

- A warning that students will use the web and that they will find educational materials on it and that their lecturers ignore the web at their peril.

Findings

“World Wide Web represents a new concept in technology, the library on your desktop, the dictionary at your fingertips, the sound at your ear. There is nothing that we hear or see that will not be available through World Wide Web.” (p. 3)

Output 7

Integrating the World Wide Web into an accounting systems course, Accounting Education, an international journal, Vol. 6, No. 1, 1997, pp. 53-62. (with Christina Mulligan) [80%]

Motivation

I had been presenting papers at conferences and seminars on the use of the Internet and the web in teaching and had been discussing this with one of the first accounting academics to embrace both these technologies and integrate them into her classes: Carol E. Brown of Oregon State University (OSU). During one of our conversations at a conference in August 1995, Carol suggested that I work with her on maintaining her web-based course materials for her accounting systems classes and that we both use them as a core resource for our respective cohorts. We knew that we were among the first to do this and neither of us undertook any literature review before doing so.

Carol Brown set her students a treasure hunt as their assignment: they had to search the web for the information she listed – a very common assignment among early educational web adopters. However it required only passive input from the students – they used the web but they did not create any new information on the web while doing it. I felt I could go one better and make the assignment directly related to the web and how it might impact the future careers of my students. I wanted my students to learn how to use the technology and how to do so in a meaningful way. I have found no evidence of any accounting educator setting this type of assignment at that time.

The innovation

The website was integrated into my compulsory level three module on accounting systems in 1995/6. This was possibly the first such example of transatlantic co-operation: it was certainly the first in accounting education. We maintained the site and kept it up-to-date and students used it as one of their two principal texts during the module. The *World Wide Web* was used both to supplant traditional lecture-based teaching and as the vehicle for thirty per cent of the summative assessment on the module. Email was used for communication with the students, for submission to the tutors of their Web assignment and for feedback to the students on the assignment.

Each of the 63 students on the module was asked to prepare websites containing a report for the Board of Directors of a multi-national organisation on the use of *World Wide Web* as an information resource in business, and to teach themselves how to do so. Only 15 per cent had explored the web previously and more than 80 per cent had never seen a website before the module started. None had ever created a webpage. More than half had never used email.

By the end of the 12-week module, all the students had created their own websites and over 50 per cent had used the web as a source for material relating to other modules.

Findings

- To be useful to student learning, a website must provide students with material or resources that they believe is useful to their learning or their assessment.
- Students can be stretched and will accept having to work outside their comfort zone if they believe that doing so will be useful to them and to their careers.
- Students can enjoy attempting things they do not believe they are capable of if they believe that doing so will be useful to them and to their careers.

Output 8

How to survive a new educational era, Issues in Accounting Education, Vol. 13, No. 4, 1998, pp. 1095-1109. (with Andy Lymer) [80%]

Motivation

Output 6 had introduced colleagues to the range of resources available on the web and how to find them. By late-1996, a few accounting and finance departments had websites, but they were typically devoid of course content and links to other websites. I had seen the benefit to students and academics of having course materials and resources on a dedicated website and decided to search the web in order to construct a catalogue of what accounting and finance resources were available on university websites and websites dedicated to accounting education or finance education. I hoped that by doing so colleagues would be encouraged to experiment for themselves in how to use the technology to improve the learning experiences of their students. I adopted a perspectival approach, acting as a participative observer who interacted with what I found – i.e. I tried out the various facilities I found.

Content

Lists of entire modules (including some of my own) and short courses that were available online, along with their URLs (i.e. the address of each website I listed) and a summary of what was being done at each website and of the resources available from each one.

Findings

- Even in 1997, there was a large amount of educational resources available on the web.
- Initial use of web technology in accounting and finance education was mainly in the US: the UK was much slower in adopting the technology.
- Most of the resources at that time were of high quality.
- Some educators were using electronic class discussion lists.

- Educator websites at that time were being updated frequently, typically with little or no support from university computing centre staff – the academics were doing everything.
- Over the five months spent on this study, password protected access had started to appear on some education websites that had unrestricted access when first found.
- There were a few very large meta sites where individual educators had built webpages listing every website relevant to their subject that they had found.
- I developed a model to assist others to classify and characterise educational websites.
- Accounting and finance educators needed to be aware of the education resources that were available on the web or run the risk of their students knowing more than they did, or thinking they did. Related to this, academics had to become more conscious of change in their subjects and needed to know more about what the rest of the world knew about the subjects they were teaching. If they did not do this, they ran the risk of being found out by their students.

Output 9

Insights from internet-based research: Realising a qualitative understanding from a quantitative search process, in 'The real life guide to accounting research', Humphrey, C. and Lee, B. (eds.), 2004, pp. 309-24. (with David Tyrrall) [50%]

Motivation

I presented a paper on conducting interview-based research at a conference organised by the ICAEW in January 1996 (Sangster and Mulligan, 1996). The conference theme was qualitative research in accounting and finance. The conference organisers were hoping to publish a book containing the papers that had been presented at the conference. However, it was many years later before they secured a contract with a publisher, by which time the work I had included in the conference paper seemed (to me) to be very out-of-date. Instead of updating the paper, I suggested to the editors

that I could write a paper about my experience of undertaking Internet-based research to produce Output 8 at a time when the web as an educational and research medium was in its infancy. I suggested that I ask a former colleague from the Open University, David Tyrrell, to contribute some of his web-based research experience to the chapter and half the chapter is about David's research into the websites of small UK breweries.

Content

A description of the process of conducting web-based research, both in the early days of its existence (my research) and recently (David Tyrrell's research); and the difficulties to be faced in conducting research using the web as the main source of data and information.

Findings

The first five of these six findings encapsulate the advice I gave my students when teaching the accounting systems module described in Output 7, the work on which came after the work described in this output:

- Web-based research is being conducted in an ever-changing environment; what is there today may be gone tomorrow and what is not found one day may be found the next.
- For web-based research, the greatest problem lies in identifying where to look: using search engines versus meta sites versus drilling down through all the links at individual sites. None of these options is ideal and you only know which is best by trying them all.
- In web-based research, you must make a conscious effort to ensure that the form of enquiry matches your needs or you risk being side-tracked or overwhelmed by the sheer volume of material available.
- When conducting web-based research, it can be difficult to narrow down what is found to a manageable size.

- Web-based research needs to be flexible and reactive to what you find. There is little point in having an inflexible research question at the outset; both research questions and research methods are likely to change as resources are found.
- The two projects discussed in this output demonstrated that web-based research can be of interest to academic journals even though it is qualitative in nature.

Output 10

Using Internet-based On-line Assessment: A Case Study, Accounting Education, an international journal, Vol. 14, No. 4, 2005, pp. 383–94. (with Sally Aisbitt) [50%]

Background

Output 10 was discussed in Section 3.1.1(c). The Internet was used as the medium for the continuous assessment on the Open University course. It was also used as the vehicle for a class discussion list using Virtual Learning Environment (VLE) software. I ran the discussion list virtually single-handed in the first year the course ran. With over 550 students the course had almost four times as many students as the management accounting module I mentioned earlier on which I had used email to discuss aspects of the module with students. Nevertheless, student feedback at the end of the Open University course indicated that I had monitored and run the VLE-based discussion list effectively.

Findings

- Large cohorts can be managed effectively by one individual through VLEs.
- Managing a large VLE discussion list need not be a major task.

Summary

This sub-theme had involved me in conducting research into the state of the art in use of the internet and the web in accounting and finance education. I had done so in order to pass on my findings to other educators who might then use it in order to guide their own use of the Internet and the web in their courses. It led me to experiment in stretching students to set them tasks that required they learn how to

use in an effective way technology many of them had never seen, let alone used. They did so because I convinced them it would be useful to their future careers if they did.

Students responded well to this type of activity. As a result, when I went to the Open University, I was able to address the concerns of colleagues and administrators that students would not be able to get through a course where continuous assessment was web-based. Such was the lack of difficulty students experienced in being assessed through a web interface that they expressed their gratitude for having had their learning guided in this way. Integration of the web into my courses had taken me as far as I wished to go on using new and emerging technologies to enhance student learning.

3.1.2 Using accounting history to increasing the relevance of material to students:

Output 11

Output 11

Lessons for the classroom from Luca Pacioli, *Issues in Accounting Education*, Vol. 22, No. 3, 2007, pp. 447-57. (with Greg Stoner and Pat McCarthy) [60%]

Motivation

Around 1993, I read a paper in *Abacus* in 1990 by Previts et al. that had looked at the history of accounting and at its relevance today. I had known of and read other examples of calls for the inclusion of accounting history in the curriculum. These included Piacker (1972), the American Accounting Association (AAA)'s Bedford Committee (1986), the AAA's Accounting Education Change Commission (1990). Others include Coffman et al.'s (1993) call for more history in the curriculum and Slocum and Siram's review of the teaching of accounting history in the US in the 1980s and 90s (2001) which found that it was being included less in the curriculum than before.

I was also aware of the importance that the AAA had given to the subject in the early 1970s and that, despite recommendations to the contrary, it had decided not to proceed with establishing a special interest group on the topic; and I was aware that this decision had led to the formation of the Society of Accounting Historians in 1973.

From that initiative, research into accounting history in the English speaking world has become focused and organised in a way that simply did not exist before, with regular conferences and a refereed journal, *The Accounting Historians Journal* (which has since been extended to three following the launch of the UK-based *Accounting, Business and Financial History Journal* in the 1990s and the Australian-based *Accounting History* in this present decade).

More recently, the call for accounting history to be included in the curriculum has been repeated by Previts et al. (2006) and Richardson (2008).

It was apparent that there was interest in accounting history among accounting academics (many of whom were and are in very senior positions) and that there was interest in bringing history into the accounting classroom. This, I felt, would be a worthwhile area upon which to focus my research, one which had the potential to influence teaching and learning in the direction of “learning to learn”. I decided to start this line of research by looking at Luca Pacioli and his 1494 bookkeeping treatise.

I set out to discover whether there might be a way to use the treatise to help students to engage with and understand double entry and to learn how to apply it, so providing them with the tools to understand the process that results in amounts appearing in various ledger accounts and financial statements.

I read some papers and books about Pacioli and it appeared from the literature and from discussions with some who have undertaken research on Pacioli that it was generally felt that no-one could learn double entry from Pacioli’s treatise. Having read Geijsbeek’s (1914) translation, I was unconvinced. As a starting point, I decided to look more carefully at the treatise. In particular, (1) to discover whether reading through it while placing it in the context of Venice in the late 15th century might reveal a different view of its usefulness as an instructional text, and (2) whether there were any pedagogical devices embedded within it that might suggest that it could have been well enough constructed to have been used by someone in 1494 to teach themselves and/or others double entry bookkeeping.

Content

Pacioli's *Summa Arithmetica* and the bookkeeping treatise within it are described. A model developed to guide authors through the development of educational text (Rowntree, 1994) is used as a checklist to determine whether Pacioli's treatise would qualify as a soundly developed educational text today. The pedagogic features identified in the treatise are then compared with what textbook authors and educators do today. In order to provide a context for the analysis, a description of the environment for which Pacioli wrote the treatise is presented, including why it was written and why the text in the treatise reads like a didactic lecture.

Findings

- Pacioli's treatise contains many pedagogical devices that are seen in some of today's textbooks and classrooms, and some that we still do not universally adopt.
- There are lessons to be learnt today by both writers of textbooks and classroom teachers from Pacioli's treatise.
- Frequent references within the treatise to other ideas and concepts along with the broad contextualization of the processes of bookkeeping to legal, social, ethical, and moral codes, as well as to business practice, meant that readers of the treatise learnt double entry bookkeeping in context, rather than by learning how to apply a formulaic approach in isolation from the reality of business. As a result, readers could link what they learnt to their own knowledge and experience, see its relevance, and thus gain understanding – something most academics would aspire to with their students but, as research shows, they do not always achieve.
- The bookkeeping treatise includes advice on how to use it, something many of today's educators fail to do when encouraging students to use their textbooks.

Summary

This theme of research is ongoing. So far it has clarified the true nature of Pacioli's *Summa Arithmetica* and shown that his bookkeeping treatise could usefully be used in order to encourage students to engage with the topic of double entry and so learn and understand how to apply it. It is in the first stage of providing an example how

accounting history has a place in accounting education. As such it continues the overall theme of encouraging students to learn “how to learn” by demonstrating to them how looking at history and setting things in context enables us to understand better where we are now and so be better prepared to solve the problems we face.

Concluding Statement

This concludes the body of work presented in this thesis. This overview has demonstrated how the body of work has been undertaken and, in doing so, how it has addressed the 6Ps of Research that need to be considered in any research project (Oates, 2006):

- *Purpose* – why it was done, why it was important, what the research questions were.
- *Products* – the outcomes from the research, what it has contributed to knowledge.
- *Process* – the sequence of activities undertaken.
- *Participants* – who was studied, who shaped the nature of what was done.
- *Paradigm* – the philosophical paradigms that underlie the research. I adopted a positivist experimental paradigm in Outputs 1, 3, 4, 5, 7, and 10. All those cases involved an element of action research: I worked with the participants with a view towards changing their perception by leading them towards a position that they might regard as better than the one they were in before. In no output was this more the case than in Output 7. Outputs 2, 6, 8, 9, and 11 adopted a critical paradigm. They all looked at something as it currently stood, reflected upon it and made recommendations concerning how we could alter our behaviour in order to improve the learning process and, in doing so, guide our students towards “learning how to learn”.
- *Presentation* – the form taken to disseminate the findings, e.g. conference paper, seminar paper, journal paper, book chapter.

Table 2 shows the type of outlet and authorship of the 11 outputs included in this thesis, along with the total citations for each type of output:

Table 2: Form of Output

Published in:	Sole authored	Joint authored	Total	Citations
Refereed academic journal	3	5	8	77
Refereed book chapter	–	1	1	2
Reviewed conference proceedings	1	1	2	6
	4	7	11	85

All eleven outputs were written in order to bring new findings into the public domain, to advance the knowledge of my fellow academics so that they may make use of what I have found to the benefit of themselves and their students. They represent a coherent theme of work undertaken with the overall theme of helping students to “learn how to learn”. This is just one of a number of themes that I have pursued over the past 25 years and, when the others are added, I have 46 refereed publications every one of which has made a contribution to knowledge, including one with 55 citations in Google Advanced Scholar and another with 54.

Table 3 presents a summary of the contribution to knowledge made by each output and the citations they have each received according to Google Advanced Scholar.

Table 3: Summary of the Contributions to Knowledge and Citations of the 11 Outputs

Output	Published	Title, Contribution to Knowledge, Originality, <i>3rd Party Recognition</i>	Citations, location of cite authors, and year of latest citation
1	1991	<p><i>Knowledge Based Learning within the Accounting Curriculum</i></p> <ul style="list-style-type: none"> For rule-based topics such as accounting standards, asking students to prepare flowcharts of the rules may cause the performance of the students in their assessment to improve. <p>This was the first time I am aware of that anyone had conducted research in this area.</p> <p><i>3rd Party Recognition</i></p> <p><i>In 1995, this innovative use of expert systems at</i></p>	<p>6</p> <p>New Zealand</p> <p>UK</p> <p>USA</p> <p>2005</p>

		<i>Strathclyde in 1988/9 was recognised with my receiving the award of Outstanding Educator by the Artificial Intelligence/Expert Systems section of the American Accounting Association.</i>	
2	1992	<p><i>Computer-Based Instruction in Intermediate Accountancy Courses</i></p> <ul style="list-style-type: none"> • There was a lack of guidance in the literature concerning how to use CBI supplantively. • Recommendations were made in the paper concerning how to go about introducing supplantive CBI. <p>This was the first paper to summarise the literature and show just how sparse this form of advice was at that time.</p>	<p>2</p> <p>Australia</p> <p>UK</p> <p>2001</p>
3	1992	<p><i>Computer-Based Instruction in Accounting Education</i></p> <ul style="list-style-type: none"> • Students can learn as well from CBI as they can learn from a traditional lecture. The topic was accounting standards. The literature contains studies on a variety of topics that conclude the opposite, the same, and some which are undecided. The key underlying factor that I believe produced a positive finding in this case was that supplantive use of CBI by the students was integrated into the module – the students were made aware that I viewed the topics they learnt from CBI as being no more and no less important than those I taught in my classes with them. I believe that this flagging of the need to integrate CBI if it is to be an effective learning tool is clear in the paper, though I did not make the point specifically in the text. • Providing students with access to CBI as an optional supplement to lectures may not be an appropriate use of resources. This statement was based on dated gathered from the students in the study reported in the paper and was the first time I am aware of anyone making this point. 	<p>21</p> <p>Australia</p> <p>Ireland</p> <p>UK</p> <p>USA</p> <p>2006</p>

		<p>I have not subsequently found any examples of anyone attempting to discover whether or not this is so, though I have encountered many instances of supportive use of CBI both in my role as an external examiner and in my role as a validator of accounting programmes.</p>	
4	1992	<p><i>EQL Bookkeeping – the demise of the lecturer?</i></p> <ul style="list-style-type: none"> • Further evidence that students can learn as well from CBI as they can learn from a traditional lecture. This time the topic was double entry bookkeeping. <p>So far as I know this was the first time anyone had gone so far as to suggest that CBI could replace lecturers in the delivery of this topic.</p>	<p>4</p> <p>Australia Malaysia 2006</p>
5	1996	<p><i>Objective tests, learning to learn, and learning styles</i></p> <ul style="list-style-type: none"> • if you require students to achieve an overall percentage for a series of objective tests that is higher than the minimum pass level required for each objective test, the topic the students find most difficult should be the one tested in the final objective test. <p>I am not aware of any previous literature making this point.</p> <ul style="list-style-type: none"> • Any moves towards increasing the proportion that objective test questions represent of an overall summative assessment need to recognise that individual learning styles may impact performance. • Students should be encouraged to adjust their learning styles so as to adopt a learning strategy that is in alignment with the form of assessment they will be undertaking. <p>Both these points are commonplace in the literature on learning styles. However, this was the first time I am aware of these points being made so explicitly in the accounting education literature.</p>	<p>9</p> <p>South Africa UK USA 2007</p>

6	1995	<p><i>World Wide Web – what can it do for education?</i></p> <ul style="list-style-type: none"> I introduced the concept of the web in which I presented it as the library on your desktop. <p>Many adopted the concept, but I know of none who predated me. It was a wake-up call to all academics to which many responded.</p> <p><i>3rd Party Recognition</i></p> <p><i>I was invited to present a 3-hour public lecture on this topic in Singapore in February 1996.</i></p>	<p>24</p> <p>Australia</p> <p>India</p> <p>New Zealand</p> <p>UK</p> <p>USA</p> <p>2003</p>
7	1997	<p><i>Integrating the World Wide Web into an accounting systems course</i></p> <ul style="list-style-type: none"> If we succeed in making assignments appear relevant to the future careers of students, we can set them tasks that are in excess of what would be considered “normal”. We can lead them out of their comfort zones and open their eyes to what they may be capable of doing. <p>This is the first time I am aware of anyone presenting results of a teaching innovation that involved use of the web where students were successfully guided outside their comfort zones.</p>	<p>8</p> <p>Australia</p> <p>UK</p> <p>USA</p> <p>2004</p>
8	1998	<p><i>How to survive a new educational era</i></p> <ul style="list-style-type: none"> A “here’s how it could be done” paper. It presented an overview of how the web was being used in education globally. It described the various ways the web was being integrated into courses and, in some cases, was being used to deliver entire courses online. <p>I know of no earlier paper on this topic.</p>	<p>8</p> <p>Australia</p> <p>Croatia</p> <p>UK</p> <p>USA</p> <p>2006</p>
9	2004	<p><i>Insights from internet-based research: Realising a qualitative understanding from a quantitative search process</i></p> <ul style="list-style-type: none"> The article highlights some of the problems that may be encountered by anyone who uses the web as the source for primary data. 	<p>2</p> <p>UK</p> <p>2006</p>

		Although Output 9 contains an account of research in the early years of the web, what it describes is just as relevant today for anyone undertaking web-based research.	
10	2005	<p><i>Using Internet-based On-line Assessment: A Case Study</i></p> <ul style="list-style-type: none"> • Students that do well in summative objective tests may also do well in traditional written examinations if the summative assessment has helped guide, pace and reinforce their learning. <p>The literature on objective tests suggests that students who do well on continuous assessment do not do so well on traditional written examinations, and vice versa. This study is the only one I am aware of which found that the students were performing as well on objective tests as they were performing on traditional examinations. That is, that the objective tests were guiding learning to the point that this appears to have directly impacted students' deeper understanding of the subjects they were studying.</p>	1 UK 2007
11	2007	<p><i>Lessons for the classroom from Luca Pacioli</i></p> <ul style="list-style-type: none"> • Pacioli's treatise was as carefully constructed as distance learning materials and textbooks are prepared today. <p>No-one had previously used a developmental model of this type to assess this aspect of the treatise.</p>	0 –

I believe that I have made a significant contribution to knowledge in these 11 outputs and that the commentaries presented above on these 11 outputs demonstrate and support this view. I therefore believe that the conditions for the award of the degree of Doctor of Philosophy by publication have been met.

4. References

Accounting Education Change Commission (AECC), *Position Statement Number One: Objectives of Education for Accountants*, Accounting Education Series Volume No. 13 (1990), Sarasota: American Accounting Association.

American Accounting Association (AAA) (1986), Committee on the Future Structure, Content, and Scope of Accounting Education (The Bedford Committee), *Future Accounting Education: Preparing for the Expanding Profession*, Issues in Accounting Education, Spring, pp. 168-95.

Blake, J. (1988), *Accounting Standards*, 2nd ed., London: Financial Times – Prentice Hall.

Cleveland, F. A. (1904), in Haskins, C.W. *Business Education and Accountancy*. New York: Harper and Brothers, pp. viii-ix.

Coffman, E. N., R. H. Tondkar, and G. J. Previts. (1993), *Integrating Accounting History into Financial Accounting Courses*, Issues in Accounting Education, Spring, pp. 18-39.

Fogarty, T. J. and Goldwater, P.M. (1992), *Instructor Control in an automated environment: a reconsideration with empirical evidence*, Accounting Education, an international journal, Vol. 1, No. 4, pp. 293-310.

Geijsbeek, J. B., (1914), *Ancient Double Entry Book-keeping*, Denver: Geijsbeek.

Hollander, A.S., Denna, E.L. and Cherrington, J.O. (1996) *Accounting, Information Technology, and Business Solutions*, Chicago: Irwin.

Honey, P. and Mumford, A. (1992), *The Manual of Learning Styles*, Maidenhead: Peter Honey.

McCarthy, P., Sangster, A., and Stoner, G. (2008), *Pacioli and Humanism: pitching the text in Summa Arithmetica*, Accounting History, Vol. 13, No. 2: 183-206.

McCourt-Larres, P. and Radcliffe, G. (2000), *Computer-based instruction in a professionally-accredited undergraduate tax course*, Accounting Education, an international journal, Vol. 9, No. 3, pp. 243-57.

- Oates, B.J. (2006), *Research Information Systems and Computing*, London: Sage.
- Pacioli, L. (1494), *Sūma de Arithmetica, Geometria, Proportioni et Proportionalita*, Venice: Paganino de Paganini da Brescia.
- Piaker, P. M., (1972), The Use of Medieval Statements for Teaching Accounting, *The Accounting Review*, Vol. 47, No. 3, pp. 609-10.
- Previts, G. J., Parker, L. D. and E. N. Coffman, (1990), Accounting History: Definition and Relevance, *Abacus*, Vol. 26, No. 1, pp. 1-16.
- Previts, G. J., Flesher, D. L., and W. D. Samson, (2006), Using historical research in the classroom. In *Reflections on accounting education research*, L. M. Smith (ed.) Sarasota, FL: American Accounting Association Teaching and Curriculum Section, pp. 17-43.
- Richardson, A. J. (2008), *Strategies in the development of accounting history as a discipline*, *Accounting History*, Vol. 13, No. 3, pp. 247-80.
- Rowntree, D. (1994), *Preparing Materials for Open, Distance and Flexible Learning*, London: Kogan Page.
- Sangster, A. (1986), *Are you making the most of your spreadsheet?*, *Accountancy Age*, 30-1-86, pp.16-17.
- Sangster, A. (1991), *Workbook of Accounting Standards*, London: Pitman Publishing.
- Sangster, A. (2007), *The Printing of Luca Pacioli's Summa Arithmetica in 1494*, *Accounting Historians Journal*, Vol. 34, No. 1, pp. 125-46.
- Sangster, A. (2008), *Using accounting history and Luca Pacioli to teach double entry*, 20th Accounting, Business & Financial History Conference, Cardiff, 11th-12th September.
- Sangster, A. and Mulligan, C. (1996), *Practical difficulties of interview-based research*, ICAEW Beneath the Numbers Conference, Portsmouth, January 4th-5th.
- Sangster, A., Stoner, G., and McCarthy, P. (2008), *The Market for Luca Pacioli's Summa Arithmetica in 1494*, *Accounting Historians Journal*, Vol. 35, No. 1, pp. 111-34.

Slocum, E.L, and Siram, R.S. (2001), Accounting history: A survey of academic interest in the U.S., *Accounting Historians Journal*, Vol. 28, No. 1, pp. 111-30.

Tahinakis, P., Ginoglou, D., and Protogeros, N. (2006), *Segmental identification of research and development costs in investment decisions by the Greek banking sector*, *International Journal of Financial Services Management*, Vol. 1, No. 2-3, pp. 308-21.

Wood, F. and Sangster, A. (2008), *Business Accounting 1*, 11th edition, Harlow: Pearson Education.

Wood, F. and Sangster, A. (2008), *Business Accounting 2*, 11th edition, Harlow: Pearson Education.

5. List of Total Publications and Research Funding

Publications

(The publications highlighted and in bold are those submitted for the award of PhD)

Refereed Journal Papers

Published [33]

Accounting History [4]

1. *The market for Luca Pacioli's Summa Arithmetica*, The Accounting Historians Journal, Vol. 35(1), 2008, pp. 111-34 [with Stoner, G. and McCarthy, P.A.] (I was 90% author).
2. *Pacioli and Humanism: pitching the text in Summa Arithmetica*, Accounting History, Vol. 13(2), 2008, pp. 183-206 [with Stoner, G. and McCarthy, P.A.] (I was 70% author).
3. *Lessons for the classroom from Luca Pacioli*, Issues in Accounting Education, Vol. 22, No.3, 2007, pp. 447-57 [with Stoner, G. and McCarthy, P.A.] (I was 60% author)
4. *The printing of Pacioli's Summa in 1494: how many copies were printed*, The Accounting Historians Journal, Vol. 34(1), 2007, pp. 125-46.

Education (14)

1. *Using Internet-based On-line Assessment: A Case Study* – Accounting Education, an international journal, Vol. 14, No. 4, 2005, pp. 383–94 [with Aisbitt, S] (I was 50% author)
2. *Revising Objective Tests: a case study in integration at honours level* – ALT-J, Vol. 8, No. 2, 2000, pp. 58-68 [with Maclaran, P] (I was 50% author)
3. *Translating Theory into Practice: facilitating work-based learning through IT* – Innovations in Education & Training International, Vol. 37 (1), 2000 pp. 50-58 [with Maclaran, P and Marshall, S] (I was 50% author)
4. *How to survive a new educational era* – Issues in Accounting Education (AAA), Vol. 13, No. 4, 1998, pp. 1095-1109 [with Lymer, A M] (I was 80% author)
5. *Integrating the World Wide Web into an accounting systems course* – Accounting Education, an international journal, Vol. 6, No. 1, 1997, pp. 53-62 [with Mulligan, C] (I was 80% author)

6. *Objective tests, learning to learn, and learning styles* - Accounting Education, an international journal, Vol. 5, No. 2, 1996, pp. 131-46
7. *World Wide Web - what can it do for education?* - Active Learning, Vol. 1, No. 2, July, 1995, pp. 3-8.
8. *Expert systems in accounting education - a literature guide* - Accounting Education, an international journal 4(3), 1995, pp. 283-96 (with C.E. Brown and A.A. Baldwin-Morgan) (I was 33% author)
9. *How well do accountancy students understand a set of accounts?* - Accounting Education, an international journal, Vol. 2, No 1, March 1993, pp. 53-70 [with McCombie, I] (I was 50% author)
10. *Computer-Based Instruction in Accounting Education*, Accounting Education, an international journal, Vol. 1, No. 1, 1992, pp. 13-32.
11. *Computer-based Learning in UK Accounting Education, an international journal: to support or to supplant?* - The British Journal of Educational Technology, Vol. 23, No. 2, May 1992, pp. 136-38.
12. *Knowledge Based Learning within the Accounting Curriculum* - The British Accounting Review, Vol. 23, No. 3, September 1991, pp. 243-61. [with Wilson, A] (I was 50% author)
13. *Expert Systems in the Accounting Curriculum: A Textbook Review* - The British Accounting Review, Vol. 23, No. 2, June 1991, pp. 171-78.
14. *Knowledge Based Learning – Expert Systems for Information Management*, Vol. 4, No 1, 1991, pp. 49-63. [with Wilson, A] (I was 50% author)

Systems (15)

1. *The Perrow framework and the selection of management accounting tasks for expert system development* – New Review of Applied Expert Systems, Vol 5, 1999 pp. 129-139 [with Brown, C E] (I was 50% author)
2. *Can field-based studies bridge the Accounting Information Systems research gap?* – Review of Accounting Information Systems, 1998 [with Baldwin, A] (I was 50% author)
3. *Using the World Wide Web in Accounting Research: A huge step forward or a new constraint?* – British Accounting Review, Vol 29(4), 1997, pp. 395-407. [with Baldwin, A and Lymer, A M] (I was 33% author)

4. *The Relationship between Information Technology and Corporate Financial Reporting – Information Technology and People*, Vol 10(1), 1997, pp. 11-30. [with Xiao, J and Dodgson, J H] (I was 40% author)
5. *Expert system diffusion among management accountants* - Journal of Management Accounting Research (AAA) Vol 8 (Nov), 1996, pp. 171-182.
6. *Strategy and impacts of expert systems for bank lending* - Expert Systems With Applications, Vol 11(4), 1996, pp. 455-461 [with Baldwin, A.A.] (I was 50% author)
7. *COMPASS - a bank lending adviser expert system* - Irish Accounting Review, Vol 3(2), 1996, pp 87-102 [with Mulligan, C.] (I was 95% author)
8. *The Bank of Scotland's COMPASS - The future of bank lending?* - Expert Systems With Applications, Vol 9(4), 1995, pp. 457-468.
9. *AI on the WWW - supply and demand agents* - IEEE Expert, Vol 10 (4), August, 1995, pp. 50-55 [with Brown, C; O'Leary, D; and Gasser, L] (I was 25% author)
10. *The adoption of information technology in management accounting: the expert systems experience* - Journal of Information Technology, Vol 9, 1994, pp. 159-169.
11. *Management Accounting and Expert Systems - unknown possibilities?* - The Journal of Applied Accounting Research, Vol 1, Issue 2, 1993, pp. 20-47; and (Appendix in Vol 1, Issue 3, 1993, pp139-144.
12. *Capital Investment Appraisal Techniques: a survey of current usage* - Journal of Business Finance and Accounting, Vol 20, No 3, April 1993, pp. 307-332
13. *The Automation of Accounting Practice* - Journal of Information Technology, Vol. 7, No. 2, June 1992, pp. 65-75 [with Wilson, A] (I was 20% author)
14. *Expert Systems in Management Accounting: barriers to development* - Expert Systems for Information Management, Volume 4, No 2, 1991, pp. 115-131.
15. *Expert systems and the role of the accountant* - Expertise, Issue Three, 3-87, pp.1-5.

Other Published Papers [3]

1. *Current studies of AI/ES in accounting education* - AI/ES Update, Vol. 4, No. 3, Summer, 1995, p. 7.
2. *Teaching Accounting Standards: an experiment with intelligent computer assisted learning* - Account, Vol. 2, No. 3, 1990, pp. 26-35. [with Wilson, A] (I was 50% author)

3. *Are you making the most of your spreadsheet?* - *Accountancy Age*, 30-1-86, pp.16-17.

Book Chapters

Published 10 [# =refereed (7)]

- *#Expert System Task Selection in Management Accounting – The Applicability of the Perrow Framework*, in 'Artificial Intelligence in Accounting and Auditing, vol. VI', Markus Weiner Publishers, Princetown, NJ USA, Vasarhelyi, M and Bonson, E (eds.), 2005, pp 16-23 [with Brown, C.E.]
- *#Insights from internet-based research: Realising a qualitative understanding from a quantitative search process* in 'The real life guide to accounting research', Humphrey, C and Lee, B (eds.), 2004, pp. 309-24 [with Tyrrell, D.]
- *# Expert systems in accounting research: a design science perspective* – in 'The State of AIS Research' (American Accounting Association monograph), Sutton, S and Arnold, V (eds) 2002, pp. 65-79 [with Leech, S.A.]
- *#The REA approach to business process modeling* – in *Accounting Information Systems*, 3rd edition, Hall, J., South Western/Thomson Learning, Cincinnati, Ohio, 2000, pp. 512-545. [with Hall, J.] (also in subsequent editions)
- *#Expert system applications: Accounting and Auditing* – in *The Handbook of Expert Systems*, Liebowitz, J. (ed) 1998, pp. 27.1-27.12 [with Baldwin, A. and Brown, C. E.]
- *#Expert systems applications: Finance and Investments* – in *The Handbook of Expert Systems*, Liebowitz, J. (ed) 1998, pp. 26.1-26.14 [with Back, B. and Davis, J.]
- *#Bank commercial risk assessment using an expert system* – in *Artificial Intelligence in Accounting and Auditing*, Volume 4, Vasarhelyi, M A and Kogan, A (eds.) 1998, pp. 83-96.
- *Frameworks for Studying the Impacts of Expert Systems* – in *Critical Technology II* (Lee et al., editors) (Cognizant Communication Corporation: New York) 1996, pp.1359-1366. (with Baldwin A.A.)
- *Strategy and Impacts of Expert Systems for Bank Lending* in *Critical Technology II* (Lee et al., editors) (Cognizant Communication Corporation: New York) 1996, pp. 456-463. (with Baldwin, A.A.)

- *Experiences and best practice in the use of learning technology: a personal view* – in *Implementing Learning Technology*, Stoner, G. (ed), LTDI: ICBL, Edinburgh, July 1996, pp. 14-20.

Conference Papers

Published in the Proceedings [17] (# =refereed [5])

History (1)

1. *#Using accounting history and Luca Pacioli to teach double entry*, -- In the proceedings of the Accounting, Business and Financial History Conference, Cardiff, September 2008.

Education (7)

1. *Issues to consider when using Computer-Based Assessment* – LTSN-BEST annual conference, Brighton, April 9th-11th 2003.
2. *Electronic Induction to a distance learning course: the OUBS B680 experience* – in the proceedings from the 2nd BEST Conference, Edinburgh April 8th-10th 2002.
3. *Accounting and Finance Education and the WorldWideWeb: Possibilities for Teaching Innovation* – in the selected proceedings from the 8th Annual CTI-AFM Conference, Newport, April 1997, Fletcher, K and Nicholson, A H S (eds), pp. 4-11. (with Lymer, A) (I was 99% author)
4. *World Wide Web - what can it do for accounting education?* – in the selected proceedings from the 6th Annual CTI-AFM Conference, Glasgow, March 1995, Williams, B C and Nicholson, A H S (eds), pp.16-25
5. *Accounting educator attitudes to computer assisted learning* – in the selected proceedings from the 4th Annual CTI-AFM Conference, Leicester, March 1993, Williams, B C and Nicholson, A H S (eds), pp.17-32
6. *EQL Bookkeeping - the demise of the lecturer?* – in the selected proceedings from the 3rd Annual CTI-AFM Conference, Bradford, April 1992, Williams, B C and Nicholson, A H S (eds), pp. 31-40 [with Rawlinson, D] (I was 30% author)
7. *Computer-Based Instruction in Intermediate Accountancy Courses* – in the proceedings of The Integration of Computer Based Training Materials in Higher Education Conference, Bradford University, December 1991, Holmes, G (ed) *Integrating Learning Technology in the Curriculum*, CTISS, 1992, pp. 44-48.

Systems (9)

1. *The Internet and the Small Business* – in the CD-ROM of the proceedings of the 8th Annual Internet Society Conference: INET'98 1998 (with Lymer, A. and Baldwin, A.) (I was 10% author)
2. *Expert system task selection in management accounting - the applicability of the Perrow Framework* – in the refereed proceedings of the II International Meeting on Artificial Intelligence in Accounting, Finance and Tax, Punta Umbria (Huelva), Spain, 27-28 September, 1996 Sierra, G J and Bonson, E, (eds.) pp. 31-43. (with Brown, C.E.) (I was 50% author)
3. *A Model for Understanding the Impact of the World Wide Web on Accounting Academia* – in the proceedings of the 7th Annual Research Workshop on AI/ET in Accounting, Auditing and Tax, New Orleans, Louisiana, August, 15, 1998 (with Brown, C. E.; Lymer. A.M.; and Baldwin A.) (I was 25% author)
4. *#The applicability of the Perrow Framework to expert system task selection in management accounting* – in the proceedings of the 3rd World Congress on Expert Systems, Seoul, Korea, 5-9 February, 1996, Lee, J K, Liebowitz, J, and Chae, Y M (eds), pp. 100-107 (with Brown, C.E.) (I was 50% author)
5. *#Strategy and impacts of expert systems for bank lending* – 3rd World Congress on Expert Systems, Seoul, Korea, 5-9 February, 1996, Lee, J K, Liebowitz, J, and Chae, Y M (eds), pp. 456-463 (with Baldwin-Morgan, A.A) (I was 50% author)
6. *#Frameworks for studying the impacts of expert systems* – in the proceedings of the 3rd World Congress on Expert Systems, Seoul, Korea, 5-9 February, 1996, Lee, J K, Liebowitz, J, and Chae, Y M (eds), pp.1359-1366 (with Baldwin-Morgan, AA) (I was 50% author)
7. *Commercial lending with COMPASS – an expert system* – in the refereed proceedings of the I International Meeting on Artificial Intelligence in Accounting, Finance and Tax, Matalascanas, Spain, 4-5 October 1995, Sierra, G J and Bonson, E, (eds) pp. 53-70.
8. *Strategy and impacts of expert systems for bank lending* – in the proceedings of the 4th Annual Research Workshop on AI/ES in Accounting, Auditing, and Tax, Orlando, August 1995 [with Baldwin-Morgan, A.A.] (I was 50% author)

9. *#The Bank of Scotland's lending adviser expert system, COMPASS* – in the refereed proceedings of the 11th Conference on Artificial Intelligence for Applications, February 19-22, 1995, Los Angeles. IEEE Computer Society: Washington DC, USA.

Unpublished [36]

Education (14)

1. *Exporting the RAE: Adoption of similar practices in Australia* – BAA Scottish Region conference September 2007 [with Matthews, M.R.] (I was 50% author)
2. *The impotence of the academic in an IT environment* – LTSN-BEST annual conference, Edinburgh, April 14th-16th, 2004. [with Aisbitt, S.A.] (I was 50% author and presented the paper)
3. *Wafflers and Talkers: A New Perspective on Accounting Academics* – BAA-AESIG annual conference, Bournemouth, May 21st-23rd 2003. [with Monk, L.; Hellier, C.; and Craig, R.] (I was 30% author and presented the paper)
4. *Addressing the problems of Computer-Based Assessment* – BAA-AESIG annual conference, Bournemouth, May 21st-23rd 2003.
5. *Electronic Induction to an accounting course: the OUBS B680 experience* – BAA-Accounting Education SIG Conference, Glasgow, May 2002
6. *Do We Need More Auditing?* – BAA-Accounting Education SIG Conference, Aberdeen, May 2000. (with Francis, G. and Fry, J.)
7. *Benchmarking of Degrees – will it work?* – Irish Accounting and Finance Association Annual Conference, Dublin, May 2000. (with Francis, G. and Fry, J.)
8. *Subject Benchmarking – do we need more auditing?* – British Accounting Association Annual Conference, University of Exeter, April 2000. (with Francis, G. and Fry, J.)
9. *Do We Need More Auditing? An examination of the accounting subject benchmarking group* – BAA, South Eastern Accounting Group Conference, UEA, 6th September 1999. (with Francis, G.)
10. *The Integration of World Wide Web into an Accounting Systems Course* - 7th CTI-AFM Conference, Brighton, April 2-3, 1996 (with Mulligan, C.)

11. *Student Interpretive Awareness of Financial Statements - Into the next millenium -*
The Business Educators Australasia Inc. 17th International Conference, Queensland University of Technology, 24-27 September, 1995 (with Viitakangas, L.)
12. *The identification and evaluation of attitudes to computer assisted learning among accountancy educators* – British Accounting Association Annual Conference, Glasgow, April 1993
13. *Teaching Accounting Standards: an experiment with intelligent computer assisted learning* – British Accounting Association Annual Conference, March 1989 [with Wilson, A]
14. *The Crystal Experiment* – British Accounting Association Annual Conference, March 1989

Systems (16)

1. *Management Accountant or Business Advisor? The Impact of Enterprise Systems on Management Accountants*, Keynote address at the 3rd International Conference on Enterprise Systems and Accounting, June 26th –27th, 2006, Santorini, Greece (with Leech, S. and Grabski, S.)
2. *Enterprise Resource Planning Systems: their impact on management accountants, a UK perspective* –The Digital Accounting Research Conference, Huelva, Spain, October 13th –14th 2005 (with Leech, S. and Grabski, S.)
3. *The World Wide Web and Accounting Academia*. Association for Information Systems' Americas Conference 1998 (with Baldwin, A.; Brown, C.; and Lymer, A.)
4. *The World Wide Web and Accounting Academia* – Association for Information Systems' Americas Conference, Baltimore, Maryland, August 14, 1998 (with Baldwin, A.; Brown, C.; and Lymer, A.)
5. *The applicability of the Perrow Framework to the selection of management accounting tasks for expert system development* – British Accounting Association Annual Conference, Birmingham, March 1997 (with Brown, C.E.)
6. *Field-based Studies - can they bridge the accounting information systems research gap?* - Financial Information Systems Conference, Sheffield, September 9-10, 1996 (with Baldwin-Morgan, A.A.)
7. *COMPASS – an expert system for bank lending* - American Accounting Association Annual Meeting, Chicago, August 1996

8. *Can field-based research bridge the research gap in AIS?* - 3rd AIS Research Symposium, Phoenix, February 15-17, 1996 (with Baldwin-Morgan, A.A.)
9. *Frameworks for Studying the Impacts of Expert Systems* –Third World Congress on Expert Systems, Seoul, Korea, February, 1996 (with Baldwin-Morgan A.A.)
10. *Management accountants and expert system diffusion - a UK perspective* - American Accounting Association Annual Meeting, Orlando, August 1995
11. *Loan appraisal with an expert system: COMPASS* – the Second Annual Financial Information Systems Conference, Sheffield, June 1995
12. *COMPASS – a bank lending adviser expert system* - Irish Accounting and Finance Association Annual Conference, Limerick, May 1995
13. *COMPASS – the Bank of Scotland's lending adviser expert system* - the 18th Annual Congress of the European Accounting Association, Birmingham May 1995
14. *Some present and future uses of world wide web* – the World Wide Web workshop of the 11th Conference on Artificial Intelligence for Applications, the IEEE Computer Society, Los Angeles, February 1995
15. *Management accounting expert systems: the 'real' barriers?* - American Accounting Association Annual Meeting, San Francisco, August 1993
16. *Knowledge-based systems in UK management accounting - an opportunity overlooked?* - British Accounting Association Annual Conference, Glasgow, April 1993

Education History (5)

1. *Using accounting history and Luca Pacioli to teach double entry*, 20th Accounting, Business & Financial History Conference, Cardiff, 11th-12th September 2008
2. *Luca Pacioli, Distributed Learning Pioneer*, Accounting Historians Conference, Nantes, July 2006; and 10th World Congress of Accounting Educators, Istanbul, Turkey, 8-12 November 2006
3. *Luca Pacioli, Textbook Author*, BAA AE SIG Conference, London, May 2006
4. *Luca Pacioli: education for merchants*, HEA BMAF Conference, March 2006
5. *Portrait of Fra Luca Pacioli: a reappraisal of the portrait and the context specific elements of his Treatise on Double Entry Bookkeeping*, IAAER Conference, Bordeaux, France, 29th-30th September 2005

Other (2)

6. *Beanie Babies and The End – a postmodern perspective* – Academy of Marketing Conference, Derby, 5th-7th July 2000 (with Maclaran, P)
7. *Practical difficulties of interview-based research* - ICAEW *Beneath the Numbers Conference*, Portsmouth, January 4th-5th, 1996 (with Mulligan, C.)

Books

- Frank Wood's *Business Accounting 2 (IFRS)*: 11th ed. 2008 Pearson Education [with Wood, F]
- Frank Wood's *Business Accounting 1 (IFRS)*: 11th ed. 2008, Pearson Education [with Wood, F]
- Frank Wood's *Business Accounting 2 (UK GAAP)*: 1st ed. 2008, Pearson Education [with Wood, F]
- Frank Wood's *Business Accounting 1 (UK GAAP)*: 1st ed. 2008, Pearson Education [with Wood, F]
- Frank Wood's *Business Accounting 2*: 7th ed. 1996, 8th ed. 1999, 9th ed. 2002, 10th ed. 2005, 11th ed. 2008, Pearson Education [with Wood, F]
- Frank Wood's *Business Accounting 1*: 8th ed. 1999, 9th ed. 2002, 10th ed. 2005, 11th ed. 2008, Pearson Education [with Wood, F]
- Frank Wood's *A-Level Accounting*: 2nd ed. 1998, 3rd ed. 2001, 4th ed. 2004, Pearson Education
- Frank Wood's *Business Accounting Hong Kong Edition Volume 1*: 1st ed. 1999, 2nd ed. 2002, 2nd revised ed. 2003, 3rd ed. 2007, Longman [with Wood, F; Yau, L; Yau, R; and Yau, J]
- Frank Wood's *Business Accounting Hong Kong Edition Volume 2*: 1st ed. 1999, 2nd ed. 2003, 3rd ed. 2007, Longman [with Wood, F; Yau, L; Yau, R; and Yau, J]
- *Workbook of Accounting Standards*: 1st ed. 1991, 2nd ed. 1993, 3rd ed. 1995, 4th ed. 1997, Pitman (399 pages)

Editorials

- *Accounting Education*, an international journal, Vol. 15, No. 3, 2006 [guest editorial with Marriott, N. and Gammie, E.]

- *The integration of expert systems within the accounting curriculum* - Accounting Education, an international journal, Vol. 4, No. 3, 1995, pp. 211-16 [guest editorial]
- *International Journal of Applied Expert Systems* Vol. 1, No. 1, 1993 to Vol. 2, No. 3, 1994
- *New Review of Applied Expert Systems* Vol. 1 to Vol. 5 (1995-9)
- *New Review of Applied Expert Systems and Emerging Technologies* Vol. 6 (2000) and Vol. 7 (2001)

Book and Software Reviews: 18 in a variety of academic journals

Open University Books

B680 Induction Booklet, (2002)

B680, Certificate in Accounting Books 1 and 12 (2001)

B680, Certificate in Accounting Books 2-11, 13-16 (2001) [with multiple co-authors]

Hong Kong Open University Courses

B810 Introduction to Accounting undergraduate distributed learning course (2004)

B867 Managerial Control Practice postgraduate distributed learning course (1999)

B304 Accounting Information Systems undergraduate distributed learning course (1998)

Research Funding

External

- £8,008 from the Chartered Institute of Management Accountants (2002-5) to assess the role of management accountants in Enterprise Resource Planning environments [with Professor Leech, University of Melbourne and Professor Grabski, University of Michigan] (Report to be published for CIMA by Elsevier 2008)
- £9,750 from the Institute of Chartered Accountants in England and Wales (2001-3) to ascertain the IT related skills and competencies that accounting students need to acquire. (completed)
- £40,675 to the Institute of Chartered Accountants of Scotland from the Department of Trade and Industry (1997-8) to develop a *world wide web* resource for the Institute [ICAS project leader] (completed)
- £4,595 from the Chartered Institute of Management Accountants (1992-4) to study the extent of usage by UK management accountants of expert systems technology (completed)

Internal

- £19,152 from the Aberdeen University Information Systems Committee (1995) to develop teaching resources on *World Wide Web* (completed)
- £6,995 from the Aberdeen University Research Committee (1992-3) to investigate the attitudes of accounting educators towards computer assisted learning (completed)

7. Confirmations of Contribution

7.1 Confirmation of Contribution

Output 1

Sangster, A. and Wilson, R. A. (1991), *Knowledge Based Learning within the Accounting Curriculum*, *The British Accounting Review*, Vol. 23, No. 3, pp. 243-61. [50%]

Statement of Contribution

The author played an active part in all aspects of the above joint research. Contributions were made to the design of the innovation described in the paper, to the collection, entry and analysis of data, and to the writing and revision of the paper.

Confirmation of Contribution

Alan Wilson could not be contacted.

7.2 Confirmation of Contribution

Output 4

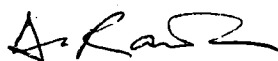
Rawlinson, D. and Sangster, A. (1992), *EQL Bookkeeping - the demise of the lecturer?*, In the selected proceedings from the 3rd Annual CTI-AFM Conference, Bradford, April 1992, Williams, B C and Nicholson, A H S (eds.), pp. 31-40. [30%]

Statement of Contribution

The author played an active part in all aspects of the above joint research. Contributions were made to the design of the innovation described in the paper, to the collection, entry and analysis of data, and to the writing and revision of the paper.

Confirmation of Contribution

This is to confirm that the statement of contribution and percentage attributed to the above paper is a true and accurate reflection of Alan Sangster's input to the research.



David Rawlinson
Formerly of The Department of Accounting
University of Aberdeen

Date: 27 September 2008

7.3 Confirmation of Contribution

Output 7

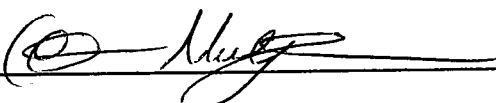
Sangster, A. and Mulligan, C. (1997), *Integrating the World Wide Web into an accounting systems course*, *Accounting Education*, Vol. 6, No. 1, pp. 53-62. [80%]

Statement of Contribution

The author played an active part in all aspects of the above joint research. Contributions were made to the design of the innovation described in the paper, to the collection, entry and analysis of data, and to the writing and revision of the paper.

Confirmation of Contribution

This is to confirm that the statement of contribution and percentage attributed to the above paper is a true and accurate reflection of Alan Sangster's input to the research.



Christina Mulligan
Formerly of The Department of Accounting
University of Aberdeen

Date: 22 September 2008

7.4 Confirmation of Contribution

Output 8

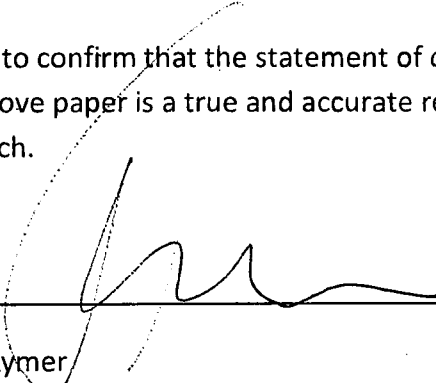
Sangster, A. and Lymer, A. (1998), *How to survive a new educational era*, Issues in Accounting Education, Vol. 13, No. 4, pp. 1095-1109. [80%]

Statement of Contribution

The author played an active part in all aspects of the above joint research. Contributions were made to the collection, entry and analysis of data, and to the writing and revision of the paper.

Confirmation of Contribution

This is to confirm that the statement of contribution and percentage attributed to the above paper is a true and accurate reflection of Alan Sangster's input to the research.



Andy Lymer

Head of Accounting and Finance Group, Birmingham Business School

University of Birmingham

email: a.m.lymer@bham.ac.uk

Date: 30th September 2008

7.5 Confirmations of Contribution

Output

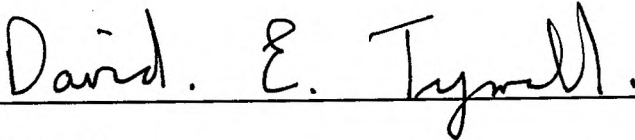
Sangster, A. and Tyrrall, D. (2004), *Insights from internet-based research: Realising a qualitative understanding from a quantitative search process*, in 'The real life guide to accounting research', Humphrey, C. and Lee, B. (eds.), pp. 309-24. [50%]

Statement of Contribution

The author played an active part in all aspects of the above joint research. Both authors shared equally in writing and revising the chapter and seeing it through to publication.

Confirmation of Contribution

This is to confirm that the statement of contribution and percentage attributed to the above chapter is a true and accurate reflection of Alan Sangster's input to the research.



David Tyrrall

Cass Business School, City University, London

email: D.Tyrrall@city.ac.uk

Date: 19 September 2008

7.6 Confirmation of Contribution

Output 10

Aisbitt, S.A. and Sangster, A. (2005), *Using Internet-based On-line Assessment: A Case Study*, Accounting Education, an international journal, Vol. 14, No. 4, pp. 383–94. [50%]

Statement of Contribution

The author played an active part in all aspects of the above joint research. Contributions were made to the design of the innovation described in the paper, to the collection, entry and analysis of data, and to the writing and revision of the paper.

Confirmation of Contribution

Sally Aisbitt died in September 2006.

7.7 Confirmations of Contribution

Output 11

Sangster, A., Stoner, G., and McCarthy, P. (2007), *Lessons for the classroom from Luca Pacioli*, *Issues in Accounting Education*, Vol. 22, No. 3, pp. 447-57 **(60%)**

Greg Stoner

Statement of Contribution

The author played an active part in all aspects of the above joint research.

Confirmation of Contribution

This is to confirm that the statement of contribution and percentage attributed to the above paper is a true and fair reflection of Alan Sangster's input to the research.

Greg Stoner
Department of Accounting and Finance
University of Glasgow
email: g.n.stoner@accfin.gla.ac.uk



Date: 21 September 2008

Output 11

Sangster, A., Stoner, G., and McCarthy, P. (2007), *Lessons for the classroom from Luca Pacioli*, *Issues in Accounting Education*, Vol. 22, No. 3, pp. 447-57 [60%]

Pat McCarthy

Statement of Contribution

The author played an active part in all aspects of the above joint research.

Confirmation of Contribution

This is to confirm that the statement of contribution and percentage attributed to the above paper is a true and fair reflection of Alan Sangster's input to the research.

Pat McCarthy
OU Business School
The Open University
email: p.a.mccarthy@open.ac.uk



Date: 22nd September 2008

8. Complete Submitted Publications

8.1 List of Submitted Publications

1. Sangster, A. and Wilson, R. A. (1991), *Knowledge Based Learning within the Accounting Curriculum*, The British Accounting Review, Vol. 23, No. 3, pp. 243-61. **[50%]**
2. Sangster, A. (1992), *Computer-Based Instruction in Intermediate Accountancy Courses*, In the proceedings of The Integration of Computer Based Training Materials in Higher Education Conference, Bradford University, December 1991, Holmes, G (ed.) Integrating Learning Technology in the Curriculum, CTISS, pp. 44-8.
3. Sangster, A. (1992), *Computer-Based Instruction in Accounting Education*, Accounting Education, an international journal, Vol. 1, No. 1, pp. 13-32.
4. Rawlinson, D. and Sangster, A. (1992), *EQL Bookkeeping - the demise of the lecturer?*, In the selected proceedings from the 3rd Annual CTI-AFM Conference, Bradford, April 1992, Williams, B C and Nicholson, A H S (eds.), pp. 31-40. **[30%]**
5. Sangster, A. (1996), *Objective tests, learning to learn, and learning styles*, Accounting Education, an international journal, Vol. 5 No. 2, pp. 131-46.
6. Sangster, A. (1995), *World Wide Web - what can it do for education?*, Active Learning, Vol. 1, No. 2, July, pp. 3-8.
7. Sangster, A. and Mulligan, C. (1997), *Integrating the World Wide Web into an accounting systems course*, Accounting Education, an international journal, Vol. 6, No. 1, pp. 53-62. **[80%]**
8. Sangster, A. and Lymer, A. (1998), *How to survive a new educational era*, Issues in Accounting Education, Vol. 13, No. 4, pp. 1095-1109. **[80%]**
9. Sangster, A. and Tyrrell, D. (2004), *Insights from internet-based research: Realising a qualitative understanding from a quantitative search process*, in 'The real life guide to accounting research', Humphrey, C. and Lee, B. (eds.), pp. 309-24. **[50%]**
10. Aisbitt, S.A. and Sangster, A. (2005), *Using Internet-based On-line Assessment: A Case Study*, Accounting Education, an international journal, Vol. 14, No. 4, pp. 383-94. **[50%]**
11. Sangster, A., Stoner, G., and McCarthy, P. (2007), *Lessons for the classroom from Luca Pacioli*, Issues in Accounting Education, Vol. 22, No. 3, pp. 447-57. **[60%]**

1. Sangster, A. and Wilson, R. A. (1991), *Knowledge Based Learning within the Accounting Curriculum*, *The British Accounting Review*, Vol. 23, No. 3, pp. 243-61.
[50%]

KNOWLEDGE-BASED LEARNING WITHIN THE ACCOUNTING CURRICULUM

ALAN SANGSTER

Department of Accountancy, University of Aberdeen

R. A. WILSON

Department of Accounting & Finance, University of Strathclyde

As the 1980s were the decade of the *spreadsheet*, so the 1990s are likely to be the decade of the *expert system*. Changes are already occurring in auditing, tax, stock market analysis, corporate funding, company valuation, merger analysis, and financial management. Accounting education will need to respond appropriately. This paper reports on an experiment which was designed to identify areas within the accounting curriculum where this technology could be introduced. It shows that it may be more economical in staff time than traditional computer-based teaching, and it found evidence of enhanced student performance compared with traditional methods.

INTRODUCTION

Over the last decade, spreadsheets, and accounting packages like *SAGE* and *Pegasus*, have entered the curriculum on most accounting courses. This is often justified on the basis that they help to reduce the drudgery of data entry and calculation, while at the same time exposing students to the tools they will encounter in the working environment. This latter point can, as suggested by Gallagher, Hoskin & Capettini (1989, p. 25), be driven by the demands of employers of accounting graduates. It can also derive from the demands of the professional accounting bodies. While it may be occasionally prudent to ignore the wishes of the former, to ignore the latter would be to restrict severely the marketability of accounting graduates. Thus, despite staff preparation time being increased by, in some cases, a factor of 70 over that which is typical for traditional material (see Williams, 1988), computer-based material has entered a significant proportion of the accounting curriculum.

A number of studies have examined the use of computers in the accounting curriculum,¹ and the use of computers for accounting instruction.² The involvement of computers in teaching, or computer assisted learning (CAL)³ as it has come to be called, can offer important educational benefits

Address for correspondence: Alan Sangster, Department of Accountancy, University of Aberdeen, The Edward Wright Building, Dunbar Street, Aberdeen AB9 2TY.

in terms of interactive learning: the learning experience can be tailored to suit the individual learner, including individual student control of pacing and management of the timing and sequencing of events. Unfortunately, while a human tutor can respond intelligently and flexibly to a wide range of student learning difficulties, the utility and functionality of conventional CAL is constrained by the intrinsic inflexibility of the procedural computer languages and development tools upon which it is based. The algorithmic nature of conventional programming makes it difficult to write interactive and adaptive applications which can respond constructively to student requirements, and this can lead to curriculum rigidity. It is also difficult to model many intellectual processes using conventional software tools.

To overcome some of these problems, attention has turned to the use of artificial intelligence (AI) concepts and technology in CAL. Of the various AI techniques it is knowledge-based, or expert, systems,⁴ which have been subject to the most intensive development. This has resulted in the creation of a wide variety of new processes for handling knowledge, and the impact upon accounting is ultimately likely to be great.⁵ Recognising that these processes may have educational, as well as commercial applications, the term *Knowledge-Based Learning* (KBL) has been devised. This may be defined as a pedagogic technique which uses the software models and tools developed for use in expert systems to fulfil educational objectives.

Existing expert systems techniques can only represent and process certain forms of knowledge. Thus, a fundamental KBL issue is the identification of those areas where the relevant domain knowledge can be adequately represented by current technology. In addition, a number of operational and economic constraints must also be overcome if KBL techniques are to be of practical value in education.

Following consideration of the suitability of knowledge-based technology for the teaching of accounting, and a statement of our research objectives, this paper describes the derivation of a model which may be used to identify and develop technologically sound, and economically and operationally viable, accounting applications for KBL.

The model we developed identified the teaching of UK Statements of Standard Accounting Practice (SSAPs) as a suitable area for KBL. The second part of the paper describes an experiment involving the use of the technique in the teaching of three SSAPs to second year accounting undergraduates.

KNOWLEDGE-BASED TECHNOLOGY

Conventional programming is based upon algorithmic routines, data representations, numeric processing and solution optimising. By contrast, expert systems achieve their functionality through special software

processes, their programming being based upon heuristic routines, knowledge representation, symbolic processing and satisficing.⁶ The development of these processes has created a set of software tools, the most important of which allow knowledge to be represented in a variety of computer processable forms, use inferential processes to generate new knowledge from existing knowledge, and provide systems with the capacity to explain and justify their conclusions. A number of these knowledge handling processes gathered together form a software tool—an expert systems shell—which can greatly simplify the creation of an expert system.

Many recent surveys⁷ have indicated that the use of expert systems for accounting purposes is increasing, both in volume and sophistication, and it has been suggested by a number of authors that accountants can acquire specialist expert skills by studying the simulation of such skills in practitioner expert systems. Speaking generally about the effects of expert system implementation, Edwards & Connell (1989, p. 38) state that

'after a certain period of use, the user finds that he has become sufficiently familiar with the system's knowledge and no longer needs to use [the system] . . . [he] becomes trained in the domain of expertise'.⁸

Dorr, Eining & Groff (1988) used a shell-based expert system, initially developed for practitioner use, to instruct accounting students in the evaluation of internal controls over payroll processing: it was claimed that the students demonstrated some improvement after the experiment. Otherwise, although expert systems have been incorporated into some accountancy courses,⁹ there has been little attempt to test the educational potential of accounting practitioner expert systems.

Much of the research into educational uses of AI has been directed towards the development of intelligent tutoring systems. These are computer systems capable of interacting flexibly and knowledgeably with learners to provide instruction which is equal, or superior, to that provided by expert human tutors (see Polson & Richardson, 1986; Deer, 1987; Wenger, 1987; Lawler & Yazdani, 1987; King & McAulay, 1991). Research in this field has produced many valuable insights into conventional educational processes but the conceptual and practical obstacles to success are considerable. There are many less ambitious ways in which AI techniques can be exploited to create worthwhile pedagogic applications, and the experiment described below was one such exploitation. Our aim was not to develop a supplantive intelligent tutoring system, but an application which could be used to support and enhance conventional educational processes.

RESEARCH OBJECTIVES

We had four research objectives, the first two being primary, the third and fourth being natural by-products of the second:

- (a) To construct a model to assist in the identification of suitable KBL accounting applications, recognising that while simple intellectual curiosity may justify the exploration of new concepts and technologies, for an innovation to enter general employment, it must be demonstrably superior to existing practices—see Shaoul (1990, p. 36).
- (b) To discover a more effective and efficient alternative to conventional pedagogic techniques; effectiveness being measured by testing if the students being taught by KBL demonstrated a superior academic performance compared with students using other methods; efficiency being measured by determining whether more staff or student time was required to complete the course.
- (c) The enhancement of students' computer literacy¹⁰ through an increase in students' computer contact time, without adding to their existing total contact hours.
- (d) The exposure of students to state-of-the-art knowledge-based technology—a similar objective to that often cited to support the involvement in teaching of commercial accounting packages, like *SAGE* and *PEGASUS*, and spreadsheets, like *LOTUS 1-2-3* and *SUPERCALC*, rather than cheaper, often less powerful, generic packages and spreadsheets.

MODEL DERIVATION

There are two major obstacles to KBL development. The first of these concerns the restrictions that arise in connection with the identification of suitable subjects (*suitability constraints*). The second concerns the practical problems associated with developing CAL applications (*developmental constraints*). Various authors have suggested criteria for other pedagogic applications of AI (e.g. Half, 1986); however, most are not relevant to the accounting domain. As a result, we derived our own model from the suitability constraints which we identified, and tested it in the development of an accounting application which it (the suitability model) indicated was a suitable area for KBL, and which satisfied the developmental constraints we faced.

Suitability constraints

The suitability model required that the domain selected fulfilled six criteria derived from the suitability constraints:

- (a) only surface knowledge required—the most common format used for knowledge representation within expert systems (and that used by the software we adopted) is 'production rules' of the form: IF

TABLE 1

A domain typology for KBL applications

	Knowledge characteristics	
	Shallow	Deep
Knowledge predictability		
Tightly bound	1	2
Loosely bound	3	4

{these conditions are met} THEN {these conclusions are true}. While production rules have a number of advantages, including conceptual simplicity and editability, they are not a subtle formalism¹¹ and are best applied to domain dependent surface knowledge, rather than domain independent deep knowledge.^{12,13}

- (b) tightly bound — typically this arises where the requisite knowledge is available in a set of rules and it is, therefore, possible to identify the expertise needed for problem solution. Table 1 shows the relationship between the surface/deep and tightly/loosely bound dichotomies; clearly, both operational and educational applications must mainly be limited to type 1 domains.
- (c) capable of 'glass box' representation — which allows students to inspect not only solutions to problems but the processes involved in reaching those solutions. (As opposed to a 'black box' representation which students may learn from by studying its solutions but cannot examine the internal processes employed to reach those solutions.)
- (d) certain information — the mechanisms for representing uncertainty in expert systems are complex, and far from theoretically satisfactory — see, for example, Bramer (1986).
- (e) existence of unsatisfactory pedagogic techniques.
- (f) subject significance — to be worthwhile, KBL applications should be directed at areas where competence is important and where there are significant real world penalties for inadequate performance. For example, accountants must be able to correctly interpret accounting standards and, therefore, it is worth experimenting with a technique which might improve students' skills in this field.

Applying the model to the students' accounting syllabus, SSAPs were identified as a suitable domain for the experiment. Having selected the experimental domain, we then considered the developmental constraints:

Developmental constraints

- (a) software — in order to reduce development times and costs (compared to those encountered under CAL) and to produce higher

quality teaching material,¹⁴ we selected CRYSTAL, an expert system shell which has been widely adopted for banking, finance and accounting applications.¹⁵

- (b) operational constraints—any application had to involve little or no additional hardware or software, and be capable of being used within the existing timetable.
- (c) enabling knowledge—in order to prevent the mechanics of the software from obscuring the educational message, we were constrained to ensure that the application required the minimum of enabling knowledge (that required for learning but not for performance) in the use of the CRYSTAL software.

Having satisfied ourselves that our approach satisfied these criteria, we proceeded with the experiment.

THE ACCOUNTING STANDARDS EXPERIMENT

Methodology

The experiment involved 65 second-year accounting undergraduates attending a course on accounting standards. The experiment was conducted over a 6-week period: three were spent on SSAP12 (Depreciation); one on SSAP13 (Research and development); and two on SSAP19 (Investment property). All the students attended the same 2-hour lecture each week. For tutorials, the students were allocated, at random, into three groups. Each of the tutorial groups met for 1 hour once a week and all the groups were presented with the same 70 problems: 30 on SSAP12; 20 on SSAP13; and 20 on SSAP19. Table 2 gives two examples of the problems employed in the SSAP13 tutorial.

All the students were required to observe *examination conditions* while working on their problems: no advice was given by tutors, and students were not allowed to consult with one another. There were differences in the tutorial approach adopted with each of the groups:

The first control group (C) of 22 students was taught by conventional methods. Students were asked to prepare for their tutorials by reading about the relevant standard. During the tutorial they worked through the problems individually.

The second control group (A) contained 23 students who were also asked to prepare for their tutorials by reading about the relevant SSAP. In addition, they were asked to prepare a flowchart, or algorithm, in respect of the SSAP.¹⁶ During the tutorial they were expected to use their algorithms to tackle the problems. They could modify their algorithms as they proceeded, if they detected any errors in them. Figure 1 shows part of an algorithm developed for SSAP13.

TABLE 2

Examples of the tutorial problems for SSAP13

The questions relate to a company which specialises in medical aids and pharmaceutical products. Current turnover is £12m and net pre-tax profit £600k. (Last year £8.1m and £360k respectively.) The company's financial year ends on 31 December.

- Q1. The company introduced a new range of breath freshener in September. It has been a huge commercial success due to the fact that it is effective for three times as long as any other product on the market. Development took place in the Spring and cost £21,000.
- Q2. For many years, the company has been in receipt of funding from a charitable trust to help it develop medical aids for the physically handicapped. The chairman has recently fallen out with the trust administrators and they have informed the company that they will no longer be assisting the company in this way. Thanks to the previous subsidy the company was able to afford to develop marginally profitable products which it would otherwise never have contemplated. During the year it spent £90,000 of its own money developing a new wheelchair. It is felt that a further £60,000 will be required to complete the project and the company has many other more profitable projects it would rather spend that amount of money on. It is unlikely that funds will be released to continue the wheelchair project in the foreseeable future.
-

The third group (E) consisted of 20 students¹⁷ who prepared for the tutorials in the same way as those in group A. During the tutorial, each student used the *CRYSTAL* shell to construct an expert system based on his/her algorithm. The expert system was then used to answer the tutorial problems. During each consultation, students could cause their expert systems to display the underlying production rules which held the knowledge on the SSAP. They could also ask the system to explain how it had reached a conclusion on a particular problem by displaying the rules that had been employed. Both the algorithms and systems could be modified during the tutorials if any errors were detected.

Prior to the experiment, all 65 students were given an explanation of the principles of expert systems. As a pilot, they studied SSAP6 (Extraordinary items and prior year adjustments) in the week before the experiment began and tackled eight problems on that standard, using the experimental approach relevant to their group. For the students in group E, this was combined with 40 minutes instructions on how to build an expert system for SSAP6, using *CRYSTAL*.

Data collection

Data was collected both during and after the experimental period: at the end of each tutorial the problem solutions from each student were collected and marked. In addition, the time taken by each group to answer the

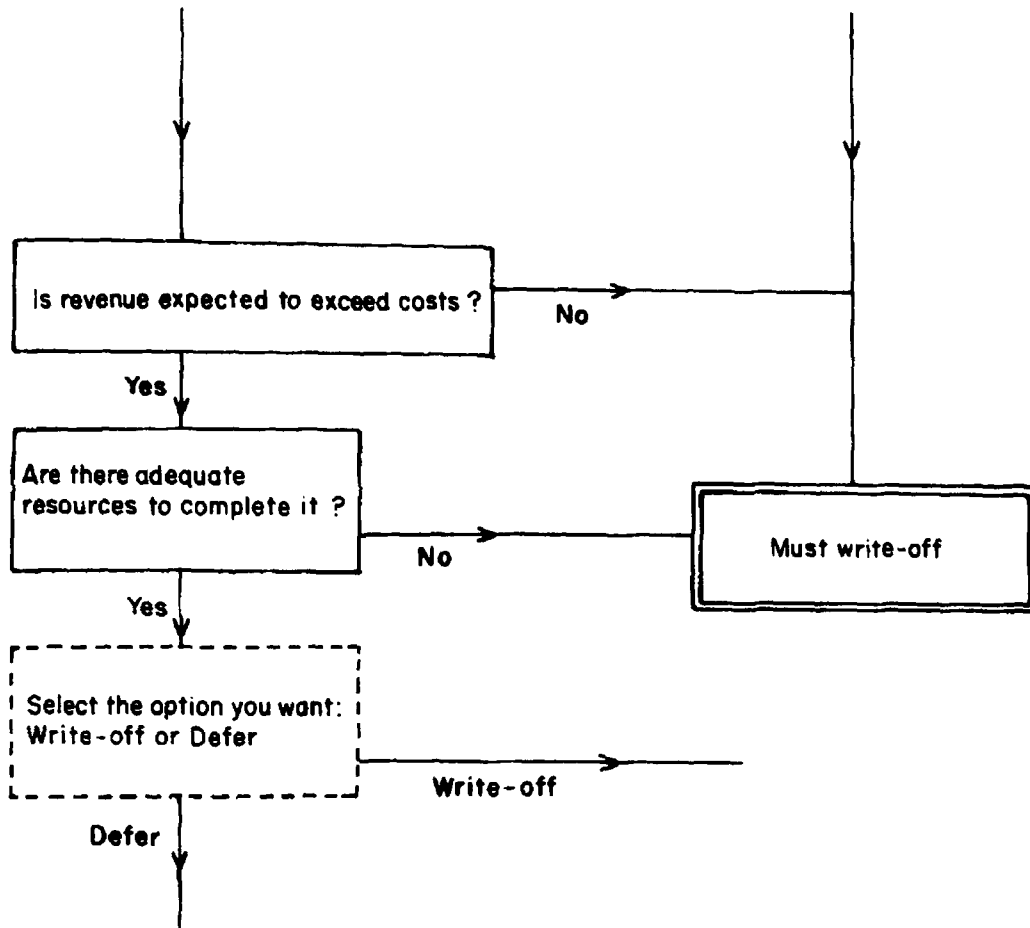


Figure 1. A section from an algorithm for SSAP13.

problems was monitored, as was the time the students in group E spent developing each expert system.

After the experimental period had ended, the students completed a questionnaire. There were different questionnaires for each group, in each case omitting those questions that were not relevant to the group being consulted. Then, 2 months after the completion of the experimental period, the students were assessed in a closed book exam. This consisted of 30 short problems on the SSAPs, similar to those used in the tutorials, and one, more traditional, longer question on SSAP13.

The results of the experiment

The results are reported in the context of the four research objectives identified earlier:

Validation of the selection model. The model was validated to the extent

TABLE 3

Tutorial percentage marks of the three groups

Group	Mean	Median	Standard deviation	Minimum	Maximum
C	52.14	50	14.40	25	85
A	58.02	60	13.68	30	90
E	61.42	60	15.87	25	90
All	57.07	60	15.04	25	90

that it correctly identified accounting standards as being a suitable area for experimentation: the experiment demonstrated that it was possible to represent and process the requisite domain knowledge in an expert system. The overall approach was also validated, to the extent that it allowed an application to be developed and used within the established constraints.

The conduct and evaluation of a KBL application:

(a) *The effectiveness of the KBL approach.* In response to the questionnaire, 60% of group E felt that their understanding of the three SSAPs had been increased through the process of programming and using the expert system; 35% that there had been no change; and 5% that it had worsened.

A more objective measure of the effectiveness of the KBL approach was provided by comparing the performance of the three groups in terms of the proportion of tutorial problems they correctly answered and the marks they achieved in the exam. The tutorial performances of the groups are shown in Table 3.

Statistical testing of these results found no evidence to support the hypothesis that group E performed significantly better than group A. However, a statistically significant result (at the 99% confidence level) was found supporting the hypotheses that students in both groups E and A performed better than those in group C.¹⁸

It was also possible that, as a result of the students becoming accustomed to the experimental process, there could have been an incremental improvement in the performance of the students over the course of the experiment. However, one-tailed *t*-tests comparing the students' performance from tutorial to tutorial, found no evidence of any statistically significant improvement by any of the groups.

Analysis of the exam performance of the students was separated into two categories: short problems, and the long question. Table 4 shows the exam short problem results.

No statistically significant difference in performance was found between the three groups.

TABLE 4

Short problem percentage marks of the three groups

Group	Mean	Median	Standard deviation	Minimum	Maximum
C	66.37	70	11.24	35	84
A	68.69	71	10.32	39	86
E	66.36	66	11.36	43	87
All	67.19	70	10.85	35	87

Table 5 shows the exam long question results. While a significant difference in performance was found between groups E and C (at the 95% confidence level), none was found between groups E and A, nor between groups A and C.

Overall, in the short term, the KBL approach was found to have been superior to the conventional approach and neither superior, nor inferior, to the algorithm approach: better answers were produced in the tutorials by *both* of the groups using new approaches, than by the conventional group. While the KBL approach was effective in the tutorial environment, in the longer term, the increase in performance it generated was not maintained under other conditions.

(b) *The efficiency of the KBL approach.* CAL techniques have to be cost effective as well as educationally effective. Each hour of tutorial time for group E required approximately 30 hours of preparation by course staff.¹⁹ Once the material had been created, administering group E did not require any more effort than the other two groups. Before group E could begin to answer tutorial problems they had to construct their expert system: the average time taken to construct each one was 33 minutes. Once their expert systems had been created, the students in group E answered tutorial problems much faster (1.45 minutes each) than either group C (1.88

TABLE 5

Long question percentage marks of the three groups

Group	Mean	Median	Standard deviation	Minimum	Maximum
C	43.22	40	15.58	12.5	70
A	48.81	55	15.65	15.0	70
E	51.50	55	13.68	20.0	70
All	47.82	50	15.19	12.5	70

minutes), or group A (2.11 minutes). If the system preparation time is added to the problem answering time for group E it gives a mean time per problem of 3.10 minutes, for 20 problems; and, if the 40 minutes spent learning how to use *CRYSTAL* is also included, mean time per problem increases to 3.67 minutes (based on 70 problems). The KBL tutorial method was therefore significantly less efficient in terms of student time, unless the students had a large number of problems to answer.²⁰

If students had to solve problems on more than one SSAP during a tutorial session, the time (excluding preparation) taken by group E to answer each problem increased from 1.45 minutes to 3.01 minutes (a 108% increase). The times taken by the students in group C increased to 1.95 minutes per problem (4%), and to 2.41 minutes (14%) for group A.

There was no significant difference in the times recorded by the students in each of the three groups for pre-tutorial preparation. No correlation was found between the times spent answering the problems and the marks achieved.

Overall, more staff preparation time was involved than would otherwise have been the case, by about a factor of 10. However, once completed, staff time was not any greater than that typically spent applying traditional methods. Group E students did take longer to complete their tasks but, were this method adopted on a wider scale, many more problems could be used, thereby eliminating the time differential between the groups. However, there is no evidence that answering more problems would be of benefit to the students. Thus, while the KBL approach was shown to have the potential to be efficient if applied on a far larger scale than that adopted in the experiment, doing so could cause the approach to be over-demanding of student time.

Enhanced computer literacy. The students in group E were asked in the questionnaire how confident they had been about using a computer prior to the experiment. Their answers are shown in Table 6.

TABLE 6

Students attitude to computers prior to the experiment

Uncertain	1
Very apprehensive	6
Apprehensive	8
Confident	4
Very confident	1
	20

After the experiment, 84% of those whose confidence could have improved, felt that it had risen.

Exposure of students to state-of-the-art knowledge-based technology. This objective was also achieved. However, it is impossible to assess what ultimate benefit the students will have gained as a result. The group E students themselves were firmly of the opinion that this exposure to expert systems would be of benefit to them when they left university. Thus, whatever tangible benefits may accrue in the future, the students gained confidence in their ability to cope with expert systems.

PRINCIPAL FINDINGS

The experiment produced four principal findings relating to the KBL approach:

KBL requires far less preparation time than conventional CAL

One of the greatest barriers to the development of *CAL* is the amount of preparation time which it requires: Williams (1988) quotes a ratio of 200 hours of development time for each hour of educational material. The 30 : 1 ratio experienced under our approach represents a significant reduction and suggests that it would be worthwhile considering whether the approach may be suitable, not just in areas where *CAL* has been developed, but also in areas which have previously been considered for *CAL*, but found to be uneconomic to develop. The key to the relatively low preparation time is the role reversal procedure that is involved in the KBL approach: it is the student who teaches the computer how to think, rather than the computer that teaches the student. By transference of the responsibility for efficient programming from tutor to student, the tutor is left with the role of ensuring that the student is equipped to use the software, and that the student knows both what information is to be programmed and how best to do so. As a result, the preparation time for KBL is far less than for conventional *CAL*.

In addition, because quite sophisticated models can be built using only a few standard commands, the students found learning how to use the expert system shell particularly easy. For *LOTUS 1-2-3*, *DBASE IV*, *PEGASUS*, and many other software packages, a 40 minute lesson on how to use it would be unthinkable. Yet, with the expert system shell, it was all that was needed. Thereafter, apart from occasional requests to the tutor to help debug an error in a student's expert system, a brief handout detailing the key commands was all that most students required.

KBL accelerates student understanding of their subject

The students were involved in software development rather than being passive users of someone else's programs. This forced them to examine fully the processes they were programming. It also made knowledge explicit which would otherwise remain implicit.

Earlier, it was suggested that the KBL approach may be too expensive in terms of student time to be worthwhile. This hypothesis was based on the premise that the computer sessions replaced conventional tutorial time. If the KBL approach can be used to accelerate the students' understanding of their subject, it should be possible to use it in place of lectures, thereby leaving the tutorial time free for discussion at what should be a higher level than that appropriate when using conventional teaching methods.

KBL exposes students to problem solving and forces them to learn how to react swiftly

Students made mistakes as they built their expert systems and received real time feedback on their errors when their programs failed to function correctly. Correcting their programs gave them a better understanding of their subject. It also led them to generate new hypotheses about the nature of the model they were constructing and to develop test strategies to explain unexpected results, all within a finite time period (the tutorial hour). If they failed to complete their problems in the time allocated they knew this would be noted. As a result, students experienced time pressure in a way that is rarely encountered in the rest of their course. If KBL were adopted on a regular basis, at the very least the experience would help students to cope with the time pressure of exams.

Students using the approach are able to assess whether expert systems may be of use outside university

Eighty-four per cent of the students in group E felt that the exposure they had had to expert systems would be of benefit to them when they left university. The group E students stated that they could see the potential benefits to be gained in improved accuracy of response when expert systems were used in problem situations, and some of them even felt that students in other groups were being disadvantaged by not being allowed to use the software; they also felt that their employment opportunities had been improved. (They knew, from the introductory lecture on expert systems given to all 65 students, that many accounting firms were actively engaged in developing and using expert systems.)

CONCLUSIONS

The experiment accomplished all the set objectives to varying degrees, and it resulted in the development of an application which could be used to support and enhance conventional educational processes.

Shaoul (1990, p. 38), when referring to spreadsheet-based CAL, states that it should

'promote active student involvement in the solution process by requiring the student to check the reasonableness of the answer...the solution process needs to be...transparent to the student...[spreadsheet-based CAL] permits the student 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'.

The accounting standards experiment evidenced all these processes. The result, as Shaoul continues, is that

'the student is provided with some feedback as to his/her performance...this encourages them to persevere until they have completed the work satisfactorily'.

On this basis alone the experiment can be adjudged a success: students did persevere, they did want to get the *correct* answer. It became a challenge, an educational game, to see whether they could crack the system. The students failed to exhibit the aura of resigned acceptance that typified student attitudes to the traditional tutorial format, an observation which was supported by the comment made by some students at the end of the course that they had found the experience interesting and stimulating.

Other means could have been used to achieve the same ends, for example, more traditional CAL; and they are not, in themselves, substantive arguments for KBL. Nevertheless, given the preparation time ratio of KBL, it may prove to be an economic alternative to the more conventional CAL approaches.

The value of any educational application must ultimately be measured by whether it can convincingly demonstrate that it is equal, or superior, to other pedagogic techniques. Assessed on the basis of student performance in tutorials, the accounting standards application passed this test. This might have been because the group E students had acquired a better understanding of the three standards (*accelerated learning*) as a result of the level of analysis they had to pursue in order to build their expert systems. However, this accelerated learning could also have resulted from their trying harder because they were using a novel piece of software, a form of Hawthorne Effect, as might the algorithm group who were also using a novel approach (which would help explain why the latter was so close in performance to the expert system group).

It may also be that the students in group E had a better record at answering tutorial problems than those in group C because their expert systems, once created, were more consistent at problem solving than the unaided efforts of the students in the other group; the performance of the students in group A may have been better than those in group C because their use of an algorithm to solve the problems allowed them to be more consistent; and the marginal difference between groups E and A could

have been due to the logic error pinpointing capabilities of the expert system software. However, observation of the students in the tutorials, where amendments to their flowcharts and expert systems were commonplace, suggests that this is more likely to have been an additional contributing factor, rather than the primary reason for their superior performance; and it would be surprising if students did not increase their understanding of an SSAP when they found they had made an error in their interpretation of it.

It could be argued that the techniques used by both groups A and E allowed better problem resolution, but that the students in those groups did not necessarily have any better understanding of the application of accounting standards, than those in group C. This view is partly supported by the exam results. However, a similar result would arise if either or both of the accelerated understanding hypotheses are correct: by the time they sat the exam, the other students had the opportunity to improve their level of understanding and raise it to that of the students in Group E.

The overall conclusion on the experiment is that the model employed to identify and develop the accounting standards application was sufficiently validated to justify its use in future; and that the form of KBL used in the experiment was effective to the extent that the students in group E performed at least as well as the other two groups in both tutorials and the exam, but not sufficiently better to justify the extra resources required for an exercise of the scale undertaken. The students in the algorithm group did almost as well as those in the expert systems group and, since this approach involved no computer resources or facilities, and no additional staff preparation, it may be worth testing this approach in other areas capable of representation in this way. Obvious examples of potentially suitable accounting related areas would include taxation, law, auditing and, of course, the remaining SSAPs.

Consideration of the model derived earlier, particularly the domain typology illustrated in Table 1, makes it clear that the KBL approach adopted in the experiment would be unsuitable for many of the areas within accounting. Given that it is desirable to expose students to the technology, an alternative strategy might be to present students with expert systems developed for practitioner use: staff preparation time would be considerably less than for the approach adopted in the experiment and, as mentioned previously, there is evidence to suggest that such exposure can lead to assimilation of knowledge. This alternative, more black box-based approach, would seem to be ready for a more substantive examination of its potential as a pedagogic device, than has been undertaken to date.

The experiment provided no reasons to advocate non-usage of KBL, other than increased staff preparation time when compared to conventional

pedagogic techniques. Given the impact that expert systems are having, and will continue to have upon accounting, it would be difficult to argue against the inclusion of the technology within the accounting curriculum. How it should be incorporated is an open question. What the experiment showed was that it can be incorporated as a problem solving pedagogic tool, without jeopardising students' understanding of the accounting concepts being taught.

NOTES

1. See, for example, Seddon (1987), Armitage & Boritz (1986), and Helmi (1986).
2. See, for example, Shaoul (1990), Oglesbee, Bitner & Wright (1988), Dickens & Harper (1986), and Fetters, McKenzie & Callaghan (1986).
3. CAL is also referred to be the abbreviations CAI (computer assisted instruction), CEI (computer enhanced instruction), and CBL (computer based learning): these terms are largely synonymous.
4. McMahon (1990, p. 5) defines an expert system as 'a computer-based system which uses symbolic reasoning to emulate the expertise and behaviour of a human expert in a particular area of knowledge or domain'.
5. See, for example, Robb & Brown (1987) and Buckner & Shah (1989).
6. For a detailed description of the contrasts between these processes and those used in conventional software see, for example, Waterman (1986) and Fordyce, Norden & Sullivan (1987).
7. See, for example, Connell (1987), Messier & Hansen (1987), Michaelson & Messier (1987), Ince (1988), Humpert & Holley (1988), and Wilson (1989).
8. For further example of the training use of expert systems, see Dungan & Chandler (1985), Torsun (1986), and Tindall & Susskind (1988).
9. For example, both Edinburgh and Aberdeen universities have included expert systems within the curriculum of their accountancy courses.
10. Seddon (1987, p. 271) defines computer literacy as 'being able to use a computer effectively and efficiently when the need arises'. He suggests that approximately 50 hours of *hands on* computing is required if students are to achieve an appropriate level of computer literacy.
11. For examples of intellectual support for representing knowledge in this way, see Newell & Simon (1972), Anderson (1983), and Holland (1986); for a discussion of the limitations of production rules, see Bramer (1986) and Alty (1986).
12. For a discussion of the distinction between shallow and deep knowledge, see Collins (1985).
13. See, for example, Woolf (1988) who examines some of the issues arising from the representation of complex knowledge in instructional systems.
14. See Williams (1988) for a discussion of the advantages of using modified commercial software packages, as opposed to conventional languages, as the bases for CAL.
15. *Crystal* is a rule based programming tool, or '*shell*', which is used to build expert systems. It is used by 9 of the top 10 UK companies, 7 of the top 8 international accounting firms, and all 6 UK clearing banks. It is also in use at over 150 UK educational establishments.
16. It was felt that it might be too difficult for the students to construct their expert systems directly from accounting standards documentation, and that they would find it easier if they first constructed an algorithm for each standard, and then used it to

- build an expert system. The introduction of this additional variable into the experiment made it necessary to have a control group for the algorithm part of the experiment so that any improvements in learning performance that resulted could be identified as either being due to the algorithm preparation, or to the use of KBL.
17. Due to software availability, we could only accommodate 20 students in the expert systems group.
 18. Expert systems should, by definition, provide expertise. This led us to the hypothesis that the expert systems group would perform better than the others. It was also hypothesised that the algorithmic representation of the knowledge would be more consistent than the unstructured knowledge of the conventional group, thereby producing better results for group A, as compared to group C. After checking all the data for normality, one-tailed *t*-tests were applied to test the hypotheses that group E performed better than both groups A and C, and that group A performed better than group C. This was done for the data in Tables 1 and 3; in the case of Table 2, a two-tailed *t*-test was used after inspection of the data suggested that this would be more appropriate.
 19. The approach adopted in the experiment required that material be prepared in order to teach students how to use the *CRYSTAL* software. This took the form of a brief user manual and a worked example based on SSAP6; in addition, expert systems were written for SSAPs 12, 13, and 19, and a bank of short questions was prepared. The total preparation time was just over 200 hours, or approximately 30 hours per group E tutorial hour. There was no requirement to be involved in the time-consuming writing of complex, fool-proof programs and sophisticated instruction manuals, which are typical of conventional CAL.
 20. As 0.43 minutes less were spent on answering each problem by students in group E, compared to those in group C, an average of 77 problems would have to have been used on an SSAP before the time taken by the group E students on that SSAP was less than that taken by those in group C. If the 40-minute learning time is also included, it would require the students to answer at least 170 problems before the total time taken by the group E students was less than that taken by those in group C.

REFERENCES

- Alty, J. L. (1986). 'The limitations of rule based expert systems'. *International Workshop on Knowledge Based Systems in Industry*, Switzerland, Brown Boveri Research Centre.
- Anderson, J. (1983). *The Architecture of Cognition*, Boston, Harvard University Press.
- Armitage, H. & Boritz, J. (1986). 'Integrating computers into the accounting curriculum', *Issues in Accounting Education*, Spring, pp. 86-101.
- Bramer, M. A. (1986). 'Expert systems in Britain: progress and prospects'. In M. A. Bramer (ed.), *Proceedings of the sixth technical conference of the British Computer Society specialist group on expert systems*, Cambridge, Cambridge University Press, pp. 1-12.
- Buckner, G. D. & Shah, V. (1989). 'Expert systems as potential managerial accounting decision support tools', *Expert Systems for Information Management*, 2(3), pp. 200-212.
- Collins, H. M. (1985). 'Where's the expertise?: expert systems as a medium of knowledge transfer'. In M. Merry (ed.), *Proceedings of the fifth technical conference of the British Computer Society specialist group on expert systems*, Cambridge, Cambridge University Press, pp. 323-334.
- Connell, N. A. D. (1987). 'Expert systems in accountancy: a review of some recent applications', *Accounting & Business Research*, 17, No. 67, Summer, pp. 221-233.
- Deer, B. L. (1987). 'Artificial intelligence & the authoring process', *IEEE Expert*, Summer.

- Dickens, T. & Harper, R. (1986). 'The use of microcomputers in intermediate accounting: effects on student achievement and attitudes', *Journal of Accounting Education*, Spring, pp. 128-146.
- Dorr, P., Eining, M. & Groff, J. (1988). 'Developing an accounting expert system decision aid for classroom use', *Issues in Accounting Education*, Vol. 3, No. 1, Spring, pp. 27-41.
- Dungan, C. W. & Chandler, J. S. (1985). 'Auditor: a microcomputer based expert system to support auditors in the field', *Expert Systems*, 2(4), pp. 210-221.
- Edwards, A. & Connell, N. A. D. (1989). *Expert Systems in Accounting*, Hemel Hempstead, Prentice Hall International (UK) Ltd.
- Fetters, M., McKenzie, J. & Callaghan, D. (1986). 'Does the computer hinder accounting education? An analysis of some empirical data', *Issues in Accounting Education*, Spring, pp. 76-85.
- Fordyce, K., Norden, P. & Sullivan, G. (1987). 'Review of expert systems for the management science practitioner', *Interfaces*, 17, No. 2.
- Gallagher, J., Hoskin, R. & Capettini, R. (1989). 'Instructional applications of personal computers and spreadsheet software in accounting: a taxonomy of objectives and methods', *British Accounting Review*, 21, No. 1, pp. 23-41.
- Half, H. M. (1986). 'Curriculum & Instruction'. In M. C. Polson & J. J. Richardson (eds), *Foundations of Intelligent Tutoring Systems*, Lawrence Erlbaum.
- Helmi, H. (1986). 'Integrating computers into the accounting curriculum', *Issues in Accounting Education*, Spring, pp. 102-111.
- Holland (1986). *Induction: process of inference, learning and discovery*, MIT Press.
- Humpert, B. & Holley, P. (1988). 'Expert systems in finance planning', *Expert Systems*, Vol. 5, No. 2, pp. 78-103.
- Ince, D. (1988). *Financial & business applications of artificial intelligence*, Information Technology Briefings.
- King, M. & McAulay, L. (1991). 'A standard costing knowledge base: building and using an expert system in management accounting education', *Issues in Accounting Education*, Vol. 6, No. 1, Spring, pp. 97-111.
- Lawler, R. W. & Yazdani, M. (eds) (1987). *AI & Education*. Vol. 1, Ablex.
- McMahon, R. G. P. (1990). *Financial decision support in smaller growth enterprises: the prospects for expert systems*, The Flinders University of South Australia Accounting and Finance Research Paper 90/1.
- Messier, W. & Hansen, J. (1987). 'Expert systems in auditing: the state of the art', *Auditing: Journal of Practice & Theory*, Fall, pp. 94-105.
- Michaelson, R. & Messier, W. (1987). 'Expert systems in Taxation', *Journal of American Taxation Association*, Spring, pp. 7-21.
- Newell, A. & Simon, H. (1972). *Human problem solving*, New York, PrenticeHall
- Oglesbee, T., Bitner, L. & Wright, G. (1988). 'Measurement of incremental benefits of computer enhanced instruction', *Issues in Accounting Education*, Vol. 3, No. 2, Fall, pp. 365-377.
- Polson, M. C. & Richardson, J. J. (eds), (1986). *Foundations of Intelligent Tutoring Systems*, Lawrence Erlbaum.
- Robb, F. & Brown, T. (1987). 'The accountant and the intelligent machine', *The Accountants Magazine*, July, pp. 38-39.
- Seddon, P. (1987). 'Computing in the undergraduate accounting curriculum: three distinct goals', *British Accounting Review*, Vol. 19, No. 3, pp. 267-276.
- Shaoul, J. E. (1990). 'Teaching accounting with computers—before and after CTI', *The CTISS File*, February, pp. 36-42.
- Tindall, C. & Susskind, R. (1988). 'Anatomy of an expert system', *Accountancy*, August, pp. 124-127.
- Torsun, I. S. (1986). 'PAYE: a tax expert system'. In M. A. Bramer (ed.), *Proceedings of*

- the sixth technical conference of the British Computer Society specialist group on expert systems*, Cambridge, Cambridge University Press, pp. 69–80.
- Waterman, S. A. (1986). 'How do expert systems differ from conventional programs?', *Expert Systems*, Vol. 3, No. 1.
- Wenger, E. (1987). *AI & tutoring systems*, Morgan Kaufmann.
- Williams, P. (1988). 'CAL production: strategies and tactics', *Computer Education*, Vol. 12, No. 1, pp. 17–21.
- Wilson, A. (1989). 'Accounting systems in industry and public practice', *The Accountants Magazine*, November.
- Woolf, B. P. (1988). 'Representing complex knowledge in an intelligent machine tutor'. In J. Self (ed.), *Artificial Intelligence and Human Learning*, Chapman Hall, pp. 1–27.

2. Sangster, A. (1992), *Computer-Based Instruction in Intermediate Accountancy Courses*, In the proceedings of The Integration of Computer Based Training Materials in Higher Education Conference, Bradford University, December 1991, Holmes, G (ed.) Integrating Learning Technology in the Curriculum, CTISS, pp. 44-8.

Computer based instruction in intermediate accountancy courses

Alan Sangster, Department of Accountancy, University of Aberdeen, Department of Accountancy, Edward Wright Building, Dunbar Street, Aberdeen AB9 2TY

This paper reports on an experiment which was designed to determine the effectiveness of PEER Statements of Standard Accounting Practice (PEER SSAPs) as an educational tool. Second year accountancy students used nine of the PEER SSAPs modules in a mixture of supplantive (ie instead of lecturer input) and supportive (ie in addition to lecturer input) modes. The study found that supplantive use of the package was as successful as lecturer based tuition, but that there was little advantage in using the package as an additional supportive facility.

Introduction

Over the course of the last year, there has been a significant change in the level of adoption of computer based instruction in UK accountancy courses. Since 1990, from a base figure of approximately 5% of courses involving some use of CBI material (extracted from data contained in the *The Source Book*¹, over 20 institutions have purchased one or more of the PEER modules and over 30, the EQL bookkeeping package. This has been particularly marked in Scotland, with all but two of the university accountancy departments, and many of the central institution and polytechnic accountancy departments having purchased PEER; and all of the university and most of the central institution and polytechnic accountancy departments having purchased EQL.

It is unclear why this change has arisen. When asked, purchasers give a range of reasons ranging from it being worth trying, to official sanction of the products (by the professional accountancy bodies). It could well be a combination of astute marketing and a growing awareness among accountancy staff that teaching methods were becoming outdated, or it could be that time pressures made the chance to switch some teaching to the computer attractive. Whatever the reason, there is certainly an established market where none existed previously. It is unlikely that those institutions who have not yet adopted these products can continue to do so indefinitely. The pressure to expand the content of courses, combined with the forecast rise of over 30% in student numbers over the rest of this decade² and the resulting worsening of staff/student ratios will leave institutions with little choice but to adopt material of this type.

Further pressure for adoption of CBI material is also being generated by the professional accounting bodies. For example, in November 1991 the Chartered Association of Certified Accountants (ACCA) issued a flyer for the PLATO CBI package (which it is distributing

through its Educational Trust) as an insert to its *Education Update* journal which is circulated to all academics involved in the training of ACCA students; and the Institute of Chartered Accountants of Scotland (ICAS) has carried articles in its journal, *The Accountants' Magazine* promoting the merits of both the packages that it markets: EQL and PEER.

The use of CBI material in accountancy education can be traced back to the 1960s, and the literature contains a number of articles on the use of computers in accountancy education from that period onwards. Some of these are theoretical^{3,4,5,6,7,8,9} but there are also some actual examples of the use of CAI and CBI. Figure 1 presents many of these and shows the level at which the approach was applied.

Only two of these represent the use of proprietary CBI material - McKeown¹⁰ and Groomer's¹¹ use of PLATO (not to be confused with the UK product of the same name). The remainder used in-house developed programs mainly written in BASIC, though spreadsheets were used in one case¹² and expert systems software in three.^{13,14,15} In only one case were students the program authors¹⁵ using expert system software.

In most cases, students used the material as a supplement to conventional lecture based tuition and it was generally found that performance was no worse than where the material was not used; though Hawkins & Allen¹¹, Freidman¹³, Groomer¹⁵, Roufaie¹⁶, Boer & Livnat¹⁷, Sangster & Wilson¹⁸, found some evidence of superior performance or understanding.

The reported use of CBI material has been at either Introductory or Intermediate level. Although it could be argued that CBI material should also be applicable to advanced level courses, the nature of the material which is currently available is such that lower level knowledge is its main commodity. While this suggests that it would be inappropriate to use the material on higher level courses as a main material source, it can nevertheless provide students with the foundations upon which

	Course Level			Type	Comments
	Intro	Intern	Adv		
Hawkins & Allen (1967)	✓			Supportive CBI	guides students through case study using prewritten program
McKeown (1976)	✓			Supportive CBI Supplative CBI	homework done on computer using PLATO; material adjusted to match student needs, based on performance diagnosis. in some areas, e.g. capital budgeting, closing process.)
Beniz (1979)		✓ (?)		Supportive CBI	problem solving tool using prewritten programs
Friedman (1981)		✓		Supportive CBI	homework done on computer using prewritten programs
Groomer (1981)	✓			Supportive CBI	supplative (in place of teaching assistant) tutorials using PLATO modules
Dickens & Harper (1986)		✓		Supportive CBI	homework done on computer using prewritten (BASIC) programs
Feters <i>et al</i> (1986)		✓		Supportive CBI	homework done on computer using prewritten (BASIC) programs
Roufael (1988)	✓			Supportive CBI	supplative (in place of teaching assistant) problem sets using prewritten (BASIC) programs with built-in HELP; answers available after a set number of attempts at a question; automatic student grading report
Ryan & Simpson (1988)	✓			Supportive CBI	optional alternative to self-study/textbook using prewritten (BASIC) programs with built-in HELP
Böer & Livnat (1990)		✓		Supportive CBI	homework done on computer using prewritten expert system (EXSYS) programs
King & Whittaker (1991)	✓			Supportive CBI CAI	spreadsheet-based tutorial exercises use of spreadsheet to demonstrate concepts (e.g. sensitivity analysis) in lectures
King & McAulay (1991)		✓		Supportive CBI	supplative tutorials using two problem solving systems - one written in PROLOG, the other, the expert system shell VP Expert; in-built HELP
Sangster & Wilson (1991)		✓		Supportive CBI	supplative tutorials involving each student writing an expert system (using the shell CRYSTAL) to apply the rules of a given SSAP
<p>Note: CBI (Computer-Based Instruction) = instruction by computer without concurrent lecturer input CAI (Computer-Assisted Instruction) = the lecturer uses the computer to demonstrate a point, for example, with the aid of a projection device</p>					

Figure 1: Reported use of CAI and CBI

advanced level courses may be built; and, as such, it could usefully be used on courses at this level. For example, at Aberdeen University, the PEER SSAP modules have been used as additional source material for project work on an advanced level course in expert systems in accountancy. While the SSAP subject material was non-examinable, the expert systems which students wrote based on the rules and regulations of the SSAPs were.

Potential dangers

A number of issues are raised by the upsurge in demand and use of packages of this type. Staff teaching the subject areas they cover may be unwilling to use them.

As a result, they may only do so as a result of external and peer pressures. This resistance may, for example, be due to personal computer illiteracy, a lack of belief that the computer can be used in this way, a complacency concerning current teaching methods, or an avoidance of something new i.e. risk aversion. Experience suggests that anyone who is truly computer literate i.e. who has wide and varied experience in the use of computers, does not panic when faced with software errors, hardware problems, and unclear instructions, and who happily experiments with new products and equipment will not be as susceptible to the other barriers as someone who is not. Clearly, forced implementation is less likely to be successful than enthusias-

tic implementation. On the other hand, enthusiastic implementation may be no less disastrous. A badly planned implementation may not just be incompatible with the learning needs of the students, but may also be incapable of detecting that it is so.

There is also the question of product quality: can purchasers realistically expect any software to be error free? Clearly the answer is *no*. Is it likely that CBI material will be any different from other proprietary software? Intuitively, it should be, for it is not the program code that is likely to be wrong (or the developers would surely have noticed). It is more likely that any errors will tend to be found in the text displayed on the screen. The comparison needs to be made, therefore, with textbook accuracy: are textbooks realistically error-free? Again, the answer must be *no*. No amount of proof reading seems capable of removing all errors. Consequently, errors should not be assumed to be nonexistent in CBI material, and they are not: for example, the first release of the PEER SSAPs modules contained both types of errors, software and text. Adopters need to validate the material prior to using it with students, or risk an otherwise well designed implementation achieving very poor results due to student dissatisfaction, disillusionment, or misunderstanding.

Finally, topic approach incompatibility between lecturer and package may require that the lecturer change to the approach adopted in the package. For example, the approach adopted in *EQL Bookkeeping for the construction of the Trading Account* is at variance with what many teachers would do. From a student perspective, use of this type of material may impose unreasonable time demands and there may be difficulties encountered in gaining adequate access to the software at socially acceptable times. A careful assessment of both computer resource availability and of the time impact that usage will have upon students is essential if these packages are to be used effectively.

Even if all these factors are addressed, there remains the problem of *how* the material should be used. As shown in Figure 1, CBI material has generally been used in a supportive way, as a reinforcing agent. Unfortunately, this type of adoption, while possibly enhancing student performance, will not reduce staff workloads. This can only be achieved through supplantive use of the material. If one of the forces driving staff towards adoption of these packages is a need to reduce staff workloads, supplantive use will require to be considered. There is insufficient evidence at present to suggest what method(s) of implementation are appropriate and any aspiring adopters need to decide how the material is to be used *and* institute an experimental mechanism which will reveal how successful the approach adopted has been.

Taking all these factors together, it is clearly essential that a carefully planned and controlled adoption process be installed. This should encompass

genuine staff acceptance that the medium is appropriate with effective product quality and resource vetting by the staff who are intending using it, along with an effective and efficient experimental process geared to ascertaining the efficacy of the approach adopted.

If the following six stage cycle for CBI adoption is followed (based on Somekh¹⁹), these problem areas can be tackled in a structured and logical way

- 1 Acceptance that CBI may be appropriate and identification of aims to be achieved through its adoption.
- 2 CBI material quality verification and computer resource verification.
- 3 Trial and error innovation.
- 4 Systematic collection of evidence (including participants' perceptions) which forms a database for evaluation and forward planning.
- 5 Theorising about action/practice - leading to changes in aims/beliefs concerning CBI.
- 6 Building with confidence on experience - incorporating change in action.

This approach can be used for CBI adoption with any level of course. It has already been applied in order to assess the efficacy of some of the modules in the *PEER SSAPs* package with an intermediate accountancy course at Aberdeen University and the experimental process and results are reported in the following section.

The study

Second year accountancy students at Aberdeen University, attend a 12 week course on SSAPs. During the course they study nine SSAPs and its aim is to provide students with lower level knowledge of these SSAPs so as to prepare them for their advanced level third year courses where the depth of analysis and understanding is raised by critical analysis of the material. In 1991, PEER SSAPs modules were integrated into the course and used in two ways - supplantively on four SSAPs (where students used them as their main source of reference and no lectures were provided), and supportively on the other five (where they had open-access to the software and could use it to add to the material given in their lectures). In previous years, each student had three tutorials, and these were converted to supervised computer labs. Students were given open-access to the computer labs at other times in order for them to have sufficient computer time to complete the exercises.

Prior to the start of the course, the software was checked and all students were given a list of eight text errors identified. A one page instruction sheet, which had been validated through a pilot exercise conducted with third year students, was issued to each student explaining how to access the package.

The overall aim was to determine whether use of the package in either a supplantive or a supportive form

was educationally effective and efficient. Success was determined from a combination of student feedback (questionnaires were issued to all students at the start, middle, and end of the experiment) and exam performance.

Findings

A range of tests were conducted on the students' examination performance and none found any significant difference between that achieved on the SSAPs taught supplantively and those taught supportively. Nor was any significant difference found between the performance of those students who had used PEER supportively and those who had not. As a vehicle for conveying lower level knowledge, the package seemed to be no better and no worse than conventional lecture delivery.

No significant difference was found in the mean time spent by students using PEER on each of the supplantive SSAPs (1.8 hours) compared to that which they spent on each of the supportive SSAPs (1.6 hours). Thus, previously having received the material in a lecture did not significantly reduce the time students spent using the package. On the basis of their examination performance, it could be worthwhile attempting to dissuade students from use of the package in a supportive way. There may be more effective ways in which students could use their time, though this must be considered in the light of the added confidence that students may derive from supportive use of the package, and of the fact that some students learning styles may be more suited to the CBI environment.

No relationship was found between student self-perceived level of confidence in using computers and their use of the package. Nor was any found between their confidence and their examination performance. However, their self-perceived confidence in the use of computers increased significantly over the course of the experiment.

When students were asked to compare the extent to which they used computers on the course with their use of it on other accounting courses, they indicated that the level of usage was appropriate and identified a lack of any computing on one of their other courses (Tax) as being inappropriate. Thus they identified an area as suitable for IT integration where staff involvement did not. This could suggest that IT integration may ultimately occur as a result of student pressure. It may also suggest that students may take it upon themselves to undertake their own IT integration through, for example, the use of spreadsheets to perform tax calculations. If this occurs, staff will need to be prepared to meet the inevitable queries that will result from students who assume their lecturers also use the technology.

Students were also asked about their use of textbooks. Over half never used a textbook while studying one of the supplantive SSAPs. This dropped to 30%

non-usage for other SSAPs. Supplantive use appeared to not only reduce student dependence on their lecturer, it also reduced their dependence on their textbooks.

The students rated lectures above PEER as a source of material, with textbooks third. However, less than a quarter preferred lectures to PEER, and less than 10% were against the suggestion that similar packages be made available for other subjects.

Students reacted well to the use of the package, and at no time did a student request help in using it. However, they displayed complete faith in the computer and generally ignored the list of errors that they were given at the start of the course. Their main criticism was that access to the software was sometimes difficult, however, no one indicated that it had resulted in their making less use of the package than they would have wished.

Conclusions

The package was found to be an effective teaching tool when used in a supplantive way on an intermediate level course. However, the study did find that supportive use may be unrewarding, other than for students whose learning style is more suited to CBI than to traditional lectures, or when treated as a confidence provider for the less secure - students whose first language is not English, for example, may benefit from this style of reinforcement. The time demand upon students was not excessive, being less than would normally be expected to be spent in peripheral study relating to a lecture topic; and students themselves believed that it was appropriate.

Were the package to be used in a supplantive way, it could enable more topics to be covered than under conventional methods (this was what occurred during the study, as previously only five SSAPs had been covered in the course). Alternatively, lecture content could move from first level information delivery, to higher level analysis and interpretation; and/or seminars and tutorials could replace lectures and be used in order to develop higher level understanding in the same time as would only be capable of generating lower level student knowledge under conventional methods. Meaningful learning²⁰ could thus occur at a far earlier point in a student's course than was possible under a traditional educational approach.

The potential of packages of this type to accelerate students through the lower level knowledge acquisition phase of their courses may ultimately be the factor which determines how widespread their use becomes. Supplantive use has been forecast elsewhere in other subject areas²¹ and the professional accountancy bodies' endorsement of these products combined with a desire that accountancy courses be recognised by these bodies may lead to accounting education being one of the leading areas for developments of this kind in the UK.

References

- 1 Nicholson A.H.S. (ed), *The Source Book*. The CTI Centre for Accounting, Finance & Management, University of East Anglia (1991).
- 2 HMSO, *Higher Education: A New Framework*. HMSO, London (1991).
- 3 Bhaskar K.N., Use of Computers in Accountancy Courses. *Accounting and Business Research* 12,49,3-10 (1982).
- 4 Kaye G.R. Teaching Strategies in Computers and Accounting. *The British Accounting Review* 17,22-36 (1985).
- 5 Armitage H.M. and Boritz J.E., Integrating Computers into the Accounting Curriculum. *Issues in Accounting Education* 1,1,86-101 (Spring 1986).
- 6 Helmi M.A., Integrating the Microcomputer into Accounting Education - Approaches and Pitfalls. *Issues in Accounting Education* 1,1,102-111 (Spring 1986).
- 7 Seddon P., Computing in the Undergraduate Curriculum. *The British Accounting Review* 19,267-276 (1987).
- 8 Er M.C. and Ng A.C., The Use of Computers in Accountancy Courses: A New Perspective. *Accounting and Business Research* 19,76,319-326.
- 9 Collier P.A., Kaye G.R., Spaul B.J. and Williams B.C., The Use of Computers in Accounting Courses: A New Perspective - A Comment. *Accounting and Business Research* 20,80,353-354 (1990).
- 10 McKeown J.C., Computer-Assisted Instruction for Elementary Accounting. *The Accounting Review* LI,123-130 (1976).
- 11 Groomer M.S., An Experiment in Computer-Assisted Instruction for Introductory Accounting. *The Accounting Review* LVI,934-941 (1981).
- 12 King R. and Whittaker J., Integrating Computers into Accounting Courses. *Account* 3,2,27-35 (1991).
- 13 Boer G.B. and Livnat J., Using Expert Systems to Teach Complex Accounting Issues. *Issues in Accounting Education* 5,1,108-119 (Spring 1990).
- 14 King M. and McAulay L., A Standard Costing Knowledge Base: Building and Using an Expert System in Management Accounting Education. *Issues in Accounting Education* 6,1,97-111 (Spring 1991).
- 15 Sangster A. and Wilson R.A., Knowledge-Based Learning Within the Accounting Curriculum. *The British Accounting Review* 23,243-261 (1991).
- 16 Hawkins D. and Allen B., Computer Assisted Case Analysis. *The Accounting Review* XLII,788-800 (1967).
- 17 Friedman M.E., The Effect on Achievement of Using the Computer as a Problem-Solving Tool in the Intermediate Accounting Course. *The Accounting Review* LVI,137-143 (1981).
- 18 Roufaiel N.S., Electronic Tutor: A Tool for Financial Accounting Education. *Issues in Accounting Education* 3,1,181-198 (Spring 1988).
- 19 Somekh B., The Evaluation of Teaching with Computers. *Account* 2,2, 30-37 (1990).
- 20 Ausubel D.P., Cognitive Structure and the Facilitation of Meaningful Verbal Learning, pp103-115. Anderson R.C. and Ausubel D.P. (eds), *Readings in the Psychology of Cognition*. New York: Holt, Reinhart and Winston, Inc. (1965).
- 21 Heath S. and Young C., Reflections on CAL in the USA. *The CTISS File* 11,33-36. CTISS Publications, Oxford (March 1991).

Bibliography

- Bentz W.G. Computer Extended Reciprocal Allocation Methods. *The Accounting Review* LIV,595-603.
- Fetters M., McKenzie J., and Callaghan D., Does the Computer Hinder Accounting Education? An Analysis of Some Empirical Data. *Issues in Accounting Education* 1,1,76-85 (Spring 1986).
- Ryan R.J. and Simpson S.M., Computer Aided Instruction for Ab Initio Teaching in Accounting. *The British Accounting Review* 20,110-130 (1988).

3. Sangster, A. (1992), *Computer-Based Instruction in Accounting Education*, *Accounting Education, an international journal*, Vol. 1, No. 1, pp. 13-32.

Computer-based instruction in accounting education

ALAN SANGSTER *

University of Aberdeen, Scotland

Received August 1991

Revised October 1991

Accepted October 1991

Abstract

The recent introduction of four computer-based instruction packages for accounting may offer an alternative to existing teaching methods, thereby providing staff with more time to undertake their other duties. This paper assesses the background to the use of packages of this type, and proposes a six-stage cycle to be followed if they are to be successfully integrated into accounting courses. A report is then given of a study into the use of nine modules from one of the packages (the PEER Statements of Standard Accounting Practice course) by a class of second-year accounting students. It finds that the modules have limited value as an additional resource, but that supplantive use (i.e. lecturer substitution) may be a practical alternative to conventional teaching; that students like the approach and wish to see it used in other areas; and that low computer literacy is no barrier to use.

Keywords: IT integration, supplantive computer-based instruction, supportive computer-based instruction, six-stage IT integration cycle, student attitudes

Introduction

The debate about the role that computers, and information technology (IT) in general, can/should play in accounting courses has been proceeding for over 20 years. Various motives have been given for the use of computers in accounting courses (e.g. American Accounting Association, 1970; Seddon, 1987); and various ways of using them have been suggested (e.g. Bhaskar, 1982; Kaye, 1985; Helmi, 1986; Er and Ng 1989; Collier *et al.* 1990).

Considered in isolation, each of these suggestions helps to provide a focus on the goals driving computer usage in accounting courses, and to suggest the options available when contemplating computer use. However, consideration of them as a unit reveals that they have all really been concerned with only two aspects: the integration of IT so as to simulate the environment which students will encounter once they graduate (including the benefit arising from use of the computational power of computers); and the use of IT as an educational support tool. This analysis is confirmed by Williams (1991) and the report on

* Address for correspondence: Mr Alan Sangster, Department of Accountancy, University of Aberdeen, Edward Wright Building, Dunbar Street, Aberdeen AB9 2TY, Scotland.

the Integration of Information Technology in Accounting Education Workshop [the *Reynolds Report*] (Reynolds, 1991).

Williams, referring to the Collier *et al.* tripart subdivided classification of computer usage (educational support tools, accountancy and business support tools, computer science) of which he was a co-author, suggests that there is no longer a compelling need for all that comprised *computer science* to be taught on accountancy courses. Instead, what he sees as the remaining essential components of *computer science* for accountancy courses – an understanding of the principles of operation of computer hardware and software tools and methods and their relationship to organizational systems – can be achieved through integration, rather than in the guise of a separate *computer science* course. He is fairly dismissive of the educational support aspect of IT integration, but recognizes that it may be a possible approach.

The *Reynolds Report* saw there being two dimensions to the integration of IT into the accounting curriculum: *integrating IT skills* (helping students acquire the appropriate knowledge and skills relevant to understanding the role of IT in business); and *integrating IT as a teaching/learning strategy* (to improve the learning experience and gain efficiencies in terms of supporting teaching staff).

Having focused the integration aspect in this way, quite apart from problems of under-resourcing (Kaye, 1990, p. 4) and staff unwillingness to integrate computers in their courses (King and Whittaker, 1991; Nicholson and Mullings, 1991), there remain considerable philosophical problems regarding how, when, and where the integration of IT skills should take place, and in the identification of the aspects of IT that need to be integrated (Reynolds, 1991). These factors are currently being addressed. For example, the Computers in Teaching Initiative (CTI) Centre for Accounting, Finance and Management is endeavouring to co-ordinate and encourage distribution of educational material and ideas; and the British Computer Society is considering the nature of IT skills required for the manager and decision maker of the future.

Clearly, it will be some time before IT skills integration of the form proposed by Williams is commonplace. However, it may be possible to accelerate this slightly by removing two popular misconceptions. The first is the argument that integration reduces the time available for students to spend on theoretical work. This is, by definition, illogical. It is also unfounded – MacDonald *et al.* (1979, pp. 40–2) refer to software's emancipatory quality – and many writers refer to the greater insights gained by students using spreadsheet and financial modelling software (e.g. Izard and Reeve, 1986).

The second misconception is that courses must contain a computer science subject if they are to gain professional accreditation. The Board of Accreditation of Educational Courses (BAEC) has moved very significantly towards a policy of IT integration. This has developed to the point where it is now acceptable for there to be no separate computing subject within a course seeking accreditation, provided that there is clear evidence of integration within the rest of the course. As the replacement of a non-accountancy department subject with an accountancy department subject raises accountancy department FTEs², awareness of the BAEC view by those in a position to alter

¹ BAEC assesses whether students should be granted exemptions from some of the examinations of the UK professional accounting bodies on the basis of the course they completed at college or university.

² Full time equivalents. This is the primary measure whereby staffing levels are determined.

courses may well provide the necessary impetus for a significant increase in IT skills integration.

Barriers to integration

Clearly, the final decision on whether to integrate IT into accounting courses rests with accounting academics. It is they who have to be convinced and, while there has been evidence in the past of an increasing number of attempts at skills integration (Kaye, 1990, p. 2), there appears to have been no significant increase over the last four years (Kaye and Nicholson, 1991a, p. 161). In addition, there is considerable scepticism concerning the feasibility of computer-based instruction (CBI) (instruction by computer without concurrent lecturer input, as opposed to computer-assisted instruction (CAI) – where the lecturer uses the computer to demonstrate a point, for example, with the aid of a projection device).

Two major staff resistance related barriers to IT integration exist: acceptance that integration is desirable, and a willingness to experiment. Reference to the following six-stage cycle for IT integration, skills or CBI, (based on Somekh, 1990, pp. 38–9), illustrates the importance of these two barriers:

1. acceptance that integration may be desirable and identification of aims to be achieved through its adoption
2. material acquisition and quality verification
3. trial and error innovation
4. systematic collection of evidence (including participants' perceptions) which forms a database for evaluation and forward planning
5. theorising about action/practice – leading to changes in aims/beliefs concerning integration
6. building with confidence on experience – incorporating change in action.

Stage two may precede stage one but if there is no belief that integration may be desirable, no move will ever be made towards stage three; and, even if the belief exists, any integration involves experimentation and a failure to do so means that no move will ever be made towards stages four, five or six.

Factors which have been suggested to explain why stage one has not been reached by a number of accounting academics include: conflicting demands on staff time (Darby, 1991); a desire to maintain the *status quo*; staff computer illiteracy³; a lack of awareness of what material is available, and a reluctance to use what is (Darby, 1991); a belief that learning in environments other than human-human will be unacceptable to students (Somekh, 1990); and an unwillingness to accept that an integrated IT approach may be more efficient for some students than traditional methods.⁴ Of these, the only true external constraint may be staff time, particularly in the non-university sector (where allocating time for research, which could be used for such activity, may not be encouraged). In the university sector, where there is an assumption that a significant

³ Attempts have been made to improve academic staff computer literacy (e.g. at the Universities of Durham (McCartan, 1990) and Bradford (Nicholson and Mullings, 1991)), but initiatives of this type are rare.

⁴ For a brief discussion of different student learning styles, see CACA (1991, p. 18).

proportion of staff time be spent on research, this constraint may only apply to self-written CBI (of which it is said that it takes 200 hours to develop one hour's worth of material). However, in neither sector does the staff time constraint apply in respect of the PEER CBI material with which this study is concerned; approximately nine hours was spent evaluating 15 hours of student material – a ratio that compares favourably with that of any other form of teaching material.

IT skills integration and CBI do change the way material is taught, the way students learn, and the material covered (Kaye, 1985); their use may also change the type of assessment required (Borthick and Clarke, 1987, p. 182). It is not surprising, therefore, that resistance to experimentation exists. Compared to doing nothing, significant time may have to be expended to meet these requirements, time which the uncommitted will find very hard to justify. However, for those who have passed stage one, time spent making changes is less likely to be a major barrier to integration, provided they are given the freedom to do so.

Making the correct choices concerning methods of integration is crucial:

'the skill of operating software is only the start, the key [to successful integration] is the way individuals use it and the way lecturers interact with students while it is in use in teaching' (Somekh, 1990, p. 38).

Unfortunately, due to a general absence among accounting academics of teaching qualifications, an understanding of teaching theories (see Kaye, 1985, p. 34), and formal knowledge of educational and learning processes (see Gray and Nicholson, 1990, p. 22), many may have difficulty in deriving a valid experimental process geared to the identification of an appropriate method of integration. Inappropriate integration is probably worse than no integration, and not knowing where to begin creates a fear that any attempt is bound to fail. This can easily result in no integration occurring, with packages being made available for students as an extra resource – the equivalent of another book in the library.

Fortunately, any lack of theoretical teaching knowledge can usually be overcome by obtaining advice from others experienced in using similar material: colleagues (though peer tuition can be unproductive (Somekh, p. 37)); external agencies (for example, in July 1991, the CTI Scottish Regional Centre for Accounting, Finance and Management held a one-day course for newcomers to CBI on how to integrate the EQL Bookkeeping CBI package into introductory accounting courses); articles in education journals and accountancy journals, and users in other institutions.

Unfairness to students is one commonly-voiced reason for non-experimentation. In the majority of cases the true reason is probably that stage one (in effect, acceptance that computers may be used advantageously in the form proposed) has not been achieved by those voicing their objection. Whatever the reason, the solution should be to attempt something on a small scale, or introduce the integration in an optional form, rather than to abandon the concept untried. If stage one can be achieved, subject to resource constraints, stage three should always proceed, albeit sometimes in a restricted form and/or with considerable third party advice and support.

Of the two classes of IT integration, it is its use for educational support in the form of computer-based instruction which is the more problematic. Resourcing and staff resistance are far more of a barrier than with IT skills integration, yet it may be that it will require the adoption of CBI before these two barriers to IT skills integration are finally

removed: successful CBI may well play the role of a 'Trojan horse' in convincing the unconvinced that skills integration may be a worthwhile pursuit. The remainder of this article is concerned with the educational merit and appropriateness of CBI.

Computer-based instruction

Despite the impression given by some authors (e.g. Er and Ng, 1989; Williams, 1991, p. 13), most of the work published on accountancy-based CBI has indicated that it may be worth considering; and there are many reports that resulting student performance is no worse than under conventional methods (see, for example, Hawkins and Allen, 1967; Friedman, 1981; Fetters *et al.* 1986; Ryan and Simpson, 1988; Böer and Livnat, 1990; Sangster and Wilson, 1991).

CBI applications can be of two types: *supplative* – lecturer substitution; and *supportive* – reinforcing lecturer input, possibly substituting for tutorial sessions. The majority of the reported examples of empirical work on accountancy-based CBI, have been concerned with supportive, rather than supplative CBI.

Supportive CBI does not simply present an alternative to textbooks, it also provides a medium for organized self study. Research in this area has largely been concerned with whether the use of supportive CBI is of benefit, occasionally considering student learning time and student attitudes. Student performance has generally been used as the principal indicator of CBI success or failure. The view running through the studies is that they were a success.

The supplative studies are mainly connected with the American PLATO project⁵ (e.g. McKeown, 1976) and there are no publicized cases of supplative accountancy-based CBI in the UK, though Neville (1983) did report a case of supplative use of self-study text units reinforced by batch processed computer diagnosis and feedback on multiple choice tests. Given the minimal evidence concerning the feasibility of supplative CBI, it is hardly surprising that the *Reynolds Report* did not envisage any supplative use of CBI (1991, p. 36). However, this is in marked contrast to the findings of Heath and Young (1991, p. 34) that the long-term scenario in Land Use disciplines in the USA was for a change in the form of student-lecturer contact whereby formal lectures would be replaced by CBI along with one-to-one and small group tutorials. In addition, Heath and Young found that, while CBI is most often used in a supportive rather than supplative role, the use of CBI in remedial teaching (where it substitutes for tutors who have insufficient time to perform the work) is seen as being a useful option – a view also held by, for example, McKeown (1976) and King and Whittaker (1991).

The evidence suggests that there may be merit in pursuing CBI in accounting education, but to what end? Even with hypertext technology⁶, writing CBI is still a time-consuming

⁵ PLATO was a nationally networked system established by the US National Science Foundation and the Control Data Corporation. It was used throughout the 1970s and contained numerous educational games and CBI packages accessible to anyone with appropriate equipment, but at a price. Boyd (1988) relates how it cost \$1100 per month for one PLATO terminal and essential services in the mid-1970s.

⁶ Hypertext is software that provides courseware authors with on-screen design, pull-down menus, and programming languages; and allows them to create a network of paths linking bits of information, which enable users to access that information using a variety of routes. Hypermedia extends Hypertext by linking other forms of media (e.g. graphics, video), and can be treated in the same way as a textbook. For more details on Hypertext and Hypermedia see the Hypertext Theme Issue of *The CTISS File* (Number 9, February 1990).

	SUPLANTIVE	SUPPORTIVE
OPTIONAL	1	2
COMPULSORY	3	4

Fig. 1. The alternatives available for CBI integration

activity (Shelton and Cairns, 1990); and the present total absence of incentives to undertake educational developments (Leaver, 1991; Kaye and Nicholson, 1991b) makes it very unlikely that any significant CBI material will be created by accounting academics within the foreseeable future. As the *Reynolds Report* states (p. 37): '[CBI] availability is largely constrained by what is being produced commercially'. These materials are generally designed for lower level learning, typically those aspects of the curriculum which comprise of facts and rules which are normally learnt through rote learning.⁷ For example, the mechanics of double entry and of financial statement preparation, regulations and the calculation of variances.

Even if CBI material were available, what objectives could any adopter reasonably hope to achieve? The previous studies suggest that equivalent student performance and staff effort, compared with those under traditional methods, would probably be as much as could be hoped for; student effort may require to increase, but there is no clear evidence that this is likely; student learning time may increase, but again there is conflicting evidence concerning this; staff time may be reduced if supplantive CBI is used, but someone may still be needed to monitor computer use; students' keyboard skills and computer literacy in general will certainly increase.

Alternative approaches to CBI integration

The time and effort effects of CBI integration will depend greatly upon the way in which the integration is pursued. Figure 1 illustrates the four typologies available.

Assuming that compulsory use will result in students making more use of CBI than they would were it optional, it will have a greater effect on student time, effort, and learning than optional use. However, for the tutor, there will be little difference between them, other than the policing function to ensure the material is used. As regards supplantive and supportive usage, student time and effort should be less on supportive than on supplantive (as some learning has already taken place), though this may not be the case if the approach is very different from that of the tutor, or if the student prefers machine instruction to human instruction. Tutor time should be considerably less for supplantive than for supportive CBI.

The greatest potential benefit for both students and staff lies with supplantive CBI. If low level learning can be transferred from the classroom to the computer lab, the classroom is free to be used to build understanding upon that low level learning. If the knowledge gained through using the CBI material helps students to build meaning and

⁷ Learning which is based on the format or wording of material which, while useful in forming a foundation on which to build understanding, adds little to the learner's understanding.

understanding from their contacts with their tutors, when previously their classes barely passed the stage of teaching them the appropriate facts, the adoption of CBI can be said to have been useful.

How much of a course could be taught using CBI depends, not just on the nature of the topics and the objectives of the course, but also upon the time that students would need to spend using the CBI material. If it is not excessive (for example, 1–2 hours to cover a topic previously presented in a lecture), students could be asked to study a CBI module prior to each class. The tutor could then choose to accelerate the students through their course, cover more material in the course, or examine the course topics in more depth.

The theoretical validity for this proposition lies in educational psychology.⁸ Knowledge (both factual information and abstract ideas) is held in the mind of the learner in an organized form. Learning is the process of adding to that knowledge. Meaningful learning involves relating what is being learnt in a non-arbitrary way to what the learner already knows. In other words, meaningful learning adds understanding to knowledge. A learner cannot have understanding until a base of knowledge has been developed. In addition, prior knowledge provides the tools to develop meaningful hypotheses; and it is prior knowledge which guides users in how to place an appropriate interpretation upon information they receive. If CBI can provide the appropriate prior knowledge, the tutor can freely build upon it. However, if the prior knowledge is inaccurate or incomplete, meaningful learning cannot occur and, at the extreme, students may have to unlearn what they absorbed from the flawed tuition. This has serious implications for those who attempt to use supplantive CBI and illustrates the importance of material quality validation and experimentation.

Another problematic aspect of supplantive CBI is that it switches the emphasis from tutor-paced instruction to student-paced instruction. This can be potentially dangerous due to the risk of students being unable to manage their own learning.⁹ Students cannot be left to use supplantive CBI material unguided. They must be encouraged and motivated to use it at the appropriate time, otherwise the problem of an inadequate base of knowledge may be just as severe as that which will arise if the material is inadequate. Referring back to Figure 1, while combination 3 (compulsory supplantive CBI) could be a valid option, there may be too much risk in using combination 1 (optional supplantive CBI).

Computer-based instruction in the UK

Only a few UK CBI applications have been reported (e.g. Ryan and Simpson, 1988; King and McAulay, 1991; Sangster and Wilson, 1991; King and Whittaker, 1991). They were all supportive in nature, and none used proprietary material. In addition, only 5% of courses identified in the 1989/90 CTI Survey (Kaye and Nicholson, 1991a) used computer assisted learning [CAL] packages; and, of these, only one sixth were identified as being proprietary CBI packages. Thus, despite the existence of at least three readily available proprietary CBI packages [Plato (not the same as the US PLATO), Ivy, and Pinstripe], take-up in the UK has been virtually nil.

⁸ See for example, Ausubel (1965).

⁹ Hartley (1985) refers to the 1975–6 TICCIT project where 5000 mathematics students were taught using supplantive CBI. The completion rate for their course under normal tuition methods was 50%. Using TICCIT, it was 16%.

This situation now appears to be in the process of changing. In May 1990, the PEER CBI courses on Statements of Standard Accounting Practice (SSAPs), Financial Accounting, and Management Accounting were introduced in Great Britain. These were followed in late 1990 by the Scottish Institute [ICAS]'s EQL Double Entry Bookkeeping CBI package, and at least one other (EQL Tax) will be available by the end of 1991. By mid-1991, over 20 universities and colleges had purchased PEER, and over 25, EQL. The modal purchase is for approximately 20 copies of each module acquired, with occasional single copy purchases amongst the English colleges. Heaviest penetration is in Scotland, with purchases by all the accounting departments in the Universities, both polytechnics, and many of the central institutions.

A telephone survey of early academic purchasers of PEER revealed that it was not purchased in order to keep-ahead of, or keep-up with other institutions; nor was it purchased because of the product's association with the three UK chartered accountancy bodies (the Irish developed it, the Scots market it, and the English and Welsh headquarters were used for its launch). Some bought it because they felt that it would be a useful additional student resource (a rather expensive book). However, the majority hoped it could be used to relieve the pressure from staff, with some seeking to do so by using it supportively in place of tutorials, while others intended to use it supplantively in place of lectures.

Unfortunately, as the packages are new, little opportunity has existed for empirical work on their efficacy and, nothing has been published indicating whether their use may benefit staff, students, and educational establishments. This lack of guidance means that adopters are having to discover for themselves how best to fit the software into the curriculum; and, as was revealed by the telephone survey, there is both considerable hesitation in experimenting with them supplantively, and uncertainty about how to plan supportive experimentation.

In the light of this lack of empirical evidence, and in a desire to ensure that a potentially valuable tool was not wasted or under-utilized, a study was undertaken in order to gain an insight into the potential efficacy and usage of one of the PEER courses – the PEER SSAPs course¹⁰ – as supplantive and supportive CBI. The remainder of this article describes the experimental process and the results obtained.

Background to the study

The study involved second-year students attending a twelve-week course which had previously covered five UK Accounting Standards (SSAPs), and had been taught using conventional methods (i.e. 12 lectures, plus one tutorial for every four lectures).

¹⁰The PEER SSAPs course is computer-based and has no written manual or textbook accompanying it. Its principal aim is to give the user the ability to both understand and apply the accounting treatment and disclosure requirements set out by each SSAP. There are 22 modules, each of which consists of a review of the background, scope and objectives of an SSAP, with definitions of terms as appropriate. A number of examples are written into the text to enable students to receive immediate feedback on their understanding of the material. Students may work through a module in the sequence presented, or they may select any of the topics, or any of the questions covered within it from the module's entry menu screen. Some screens are only activated in response to student input, and users are free to move backwards or forwards, or exit from any point within a module. There is no need to complete a module at one sitting: by noting where a session was ended, upon their return users can re-enter the module at the point at which they left.

In 1991, the teaching approach was altered: nine SSAPs were covered instead of five and the course (FA2) was taught by a combination of lectures and the PEER SSAPs package. Computer-lab time replaced the time previously allotted to tutorials. Students were taught material relating to five SSAPs (6, 9, 12, 13 and 19) in lectures. The other four (2, 4, 17 and 18) were taught supplantively through the PEER package.

By all reported estimates of necessary minimum levels of hands-on computing experience (e.g. Bhaskar, 1982, p. 88; Seddon, 1987, p. 271; Er and Ng, 1989, p. 326) the students had not received sufficient computing in their first 18 months to be considered 'computer literate'. That is, 'they were not able to use a computer effectively and efficiently when the need arose' (Sneddon, 1987, p. 271). This raised the possibility that the students could be blinded by the technology and thus unable to use software effectively (see, for example, Bentz, 1979; Fetters *et al.*, 1986). If this were the case, some time would be required at the start in order to nursemaid them in its use. However, a pilot exercise with third-year students suggested that an instruction sheet was all that was necessary; this was given to the second-year students and their first computer lab was monitored, just in case. As anticipated, no problems were encountered in using the software and lab supervision was cut to a token ten minutes, principally to ensure a full attendance.

Apart from the instruction sheet, the students were given a 20 minute briefing at the start of their first computer-lab. They were advised that they would be expected to learn about the rules of the four SSAPs from the package; and that no tuition would be given on those SSAPs from the academic staff. It was also explained that there would be questions in a mid-course class test on three of these SSAPs (the fourth was to be studied by the students in the second half of the course), and that all four would be examined in the course exam.

At no time during the course did any student request assistance with the package. This may have been due to the students generally assuming that no help would be provided. However, given their questionnaire responses concerning the use of the package and their liking for the PEER approach, it may be that they genuinely felt no need to consult their tutor.

Data analysis

Data was gathered from three questionnaires (completed before, in the middle, and at the end of the course)¹¹, the class test, and the final exam. A number of hypotheses were tested, mainly on the third questionnaire responses and the exam results. The hypothesis testing was generally by t-tests (a summary of these results is given in Appendix A), and a 95% confidence limit was used throughout. The number of students considered in each test is related to how many completed the relevant question and/or what use they made of PEER.

NUMBER OF USERS AND TIME SPENT

The first seven hypotheses considered the number of students who did each of the PEER SSAP modules, and the time they spent.

¹¹Appendix B presents a number of the questions from the third questionnaire. Copies of the three questionnaires may be obtained direct from the author.

Hypothesis 1

A one-tailed paired t-test was conducted on the hypothesis:

- H_0 : students spent the same time on average on each of the supplantive PEER modules as they spent on each of the supportive PEER modules
- v- H_1 : students spent more time on average on each of the supplantive PEER modules

The mean time spent on each of the supplantive modules by the 34 students who had used one or more of the supportive modules was 1.8 hours. On the supportive modules it was 1.6 hours. Insufficient evidence was found to reject H_0 . The students did not spend significantly longer on the supplantive modules.

Hypothesis 2

Hypothesis 2 considered the situation when lecture time was added to the PEER module times – this resulted in a mean time of 3.3 hours on the supportive SSAPs. A similar test was carried out to that on hypothesis 1 and, not surprisingly, strong evidence was found to reject H_0 . The students spent significantly longer receiving instruction on the SSAPs covered by both lectures and the supportive modules.

Hypothesis 3

Hypothesis 3 concerned the 43 students who used all four supplantive modules. Two-tailed paired t-tests were applied to the hypothesis:

- H_0 : the same time was spent on each of the supplantive modules.
- v- H_1 : the time spent was different

Insufficient evidence was found to reject H_0 for three of the modules. However, the time spent on the fourth (SSAP 4) was significantly different from the others. The mean time spent on this module was 1.74 hours, compared with 2.10, 1.96, and 1.88 hours for SSAPs 2, 17 and 18 respectively.

Hypothesis 4

Hypothesis 4 was similar, but concerned the 18 students who did all the five supportive modules. A similar result was found. Only in two cases were significant differences identified (between SSAPs 9 and 12, and 9 and 19). In all other cases no evidence was found to reject the null-hypothesis that the same time was spent on each of the supportive modules. The mean time spent on the SSAP 9 module was 1.806 hours compared with 1.292, 1.347, 1.486, and 1.539 hours for SSAPs 12, 19, 6 and 13 respectively. (Identical results were found when independent t-tests were performed using all the students, not just the 18 who had done all the supportive modules.)

Hypotheses 5, 6, 7

A χ^2 test found that there was no evidence to reject the fifth hypothesis that there was no difference in the number of students who did each of the supportive modules – 30, 30, 24, 25, and 22. However, a similar test on the supplantive modules (hypothesis 6) found that

there was a significant difference in the number who did each of them (49, 50, 43, and 49); and a significant difference was found (hypothesis 7) between the proportion of supplantive modules used¹² compared to that for the supportive modules (95.5% -v- 52.4% respectively).

It was concluded that, undirected, the average student would use just over 50% of each of the supportive modules; that a similar time would be spent on each of them; and that the time spent, while generally slightly less, would not be significantly different from that spent on each of the compulsory supplantive modules. Directed, the students would use virtually all the supplantive modules, but, lack of an immediate incentive could result in less usage than would otherwise be the case. (86% of the students used the SSAP 17 module, compared with 98% for the SSAPs 2 and 18 modules, and 100% for the module on SSAP 4. The class test was on SSAPs 2, 4, and 18.)

STUDENT EXAM PERFORMANCE

Hypothesis 8

Regression analysis failed to find any relationship between time spent using PEER and the exam marks.

Hypothesis 9

A two-tailed paired t-test was applied to the hypothesis:

H_0 : there was no difference in the students' exam performance on the supplantively taught SSAPs compared to that on the supportively taught SSAPs.

-v- H_1 : the exam performance was different

Insufficient evidence was found to reject H_0 .

Hypothesis 10

An independent one-tailed pooled t-test was then applied to the hypothesis:

H_0 : there was no difference in the students' exam performance on the SSAPs covered in lectures between the 34 students who used some of the five supportive PEER modules (mean mark 48.5%) and the 16 who used none of them (mean mark 46.6%)

-v- H_1 : the exam performance was better for those students who had used some of the supportive PEER modules

Insufficient evidence was found to reject H_0 .

Hypothesis 11

An independent one-tailed t-test was then conducted on the hypothesis:

H_0 : there was no difference in the students' exam performance on the SSAPs covered in lectures between the 18 students who used all of the five supportive PEER modules (mean mark 51.5%) and the 16 who used none of them (mean mark (46.6%))

¹² Based on the formula: $\frac{\text{total of the number of modules done by each student}}{\text{number of modules times number of students}}$

-v- H_1 : the exam performance was better for those students who had used all of the supportive PEER modules

Again, insufficient evidence was found to reject H_0 .

It was concluded that there was no apparent exam risk in using these four PEER modules in a supplantive way; and that, while students who used PEER in a supportive way on the other SSAPs scored better than those who did not, the difference in performance was not statistically significant. In addition, it was not possible to suggest an appropriate time that should be spent using each module if exam performance was to be maximized.

STUDENT COMPUTER CONFIDENCE AND COMPUTER LITERACY, AND PEER USAGE

Hypothesis 12

In the questionnaires students had been asked to describe their level of confidence in using computers on a five-point Likert scale (1 = very confident; 5 = very apprehensive). Student confidence in using computers was then compared to the number of supportive modules that they had used. Neither regression analysis, nor a X^2 test found any evidence to reject the null hypothesis that use of PEER was unrelated to the students' level of confidence.

Hypothesis 13

Similar tests were carried out on the students' perceived computer literacy. [They had been given Seddon's (1987) definition and asked to rank themselves on a five point Likert scale (1 = literate; 5 = illiterate).] As with confidence, no evidence was found to reject the null hypothesis that use of PEER was unrelated to the students' perceived level of computer literacy.

Hypothesis 14

A one-tailed paired t-test was then applied to the hypothesis:

H_0 : the students' confidence in using computers had not changed over the period that they had been using PEER

-v- H_{1i} it had increased

Evidence was found to reject the null hypothesis, the change in mean confidence from 2.78 to 2.54 was significant.

Hypothesis 15

A similar test was applied to the change in perceived computer literacy and a similar result obtained: the change in mean computer literacy from 2.80 to 2.26 was significant.

It was concluded that the use of PEER had contributed to an improvement in the students' confidence in using computers and their assessment of their computer literacy. However, use of PEER was not related to either the students' level of confidence or their level of computer literacy.

THE AMOUNT OF COMPUTER INTEGRATION

Hypothesis 16

When asked to compare the amount of computing they did in the FA2 course to that

Table 1. Students' assessment of the importance of each source of material

	<i>Supportive PEER users (34)</i>		<i>Non-supportive PEER users (16)</i>		<i>All</i>	
	μ	<i>Rank</i>	μ	<i>Rank</i>	μ	<i>Rank</i>
Lectures	3.91	1	4.25	1	4.02	1
PEER	3.68	2	-	-	-	-
Private Study	2.94	4	3.38	2	3.08	2
Textbooks	3.12	3	2.93	3	3.07	3

which they did in their second-year tax course (where there was no computing of any type), the mean response based on a five-point Likert scale (1 = far too much; 5 = far too little), was 2.94 for FA2 and 4.11 for Tax. A two-tailed paired t-test rejected the null hypothesis that there was no difference between the students' views on the amount of computing in these two courses.

Hypothesis 17

A similar test was carried out on the comparison between their views regarding the computer content of another second year course [Management Accounting (MA3)] which had the same amount of timetabled computer labs (spreadsheet-based) as FA2. Insufficient evidence was found to reject the null hypothesis that there was no difference between the students' views on the amount of computing in the MA3 and FA2 courses.

It was concluded that students felt that the supplantive and supportive use of PEER was appropriate to their course, and as appropriate as using spreadsheets was to help solve complex management accounting problems. They also felt that an absence of computing from a course which they perceived as being suitable for computer integration was inappropriate.

REPRESENTATIVENESS OF THE SAMPLE

Hypotheses 18, 19

In order to check that the 50 students who comprised the sample group were representative of the student group as a whole, two-tailed t-tests were undertaken (on the basis of marks in the exam; and in their first-year examination). No evidence was found to reject the hypothesis that the sample used were representative of the whole group.

Hypotheses 20, 21

Similar results were found when the same tests were conducted comparing those that did some of the supportive modules, with those that did none.

It was concluded that the sample were representative of the student group as a whole.

Other findings

STUDENT OPINIONS

Textbooks did not rate highly with the students. On average, 53% of them never consulted a textbook while studying one of the supplantive SSAPs. The figure for supportive SSAPs

was 30%. This finding is supported by their ranking of various sources of material, which are shown in Table 1. The rankings are based on mean ratings derived from a five-point Likert scale (with 1 = minor source; 5 = major source).

Table 1 also shows that students who used PEER supportively believe that it is of more benefit to do so than to pursue traditional private study, and that it is private study that they sacrifice rather than their textbooks.

Some 40% of the students used the supplantive modules for revision, with a similar percentage using them as a source of worked examples. In contrast over 60% used the supportive modules for revision, but less than 25% used them as a source of worked examples. Supportive use appears to have been more towards augmenting, checking and revising notes rather than attempting to understand and apply the rules, whereas supplantive use was more towards initial note taking and attempting to understand and apply the rules. Additional questions are available for all the PEER modules and it may be more worthwhile using these if PEER is being used supplantively.

The students did not find the SSAP modules difficult: on a five-point Likert scale (1 = very easy; 5 = very difficult) the mean score the students gave for each of the SSAP modules ranged from 2.41 (SSAP 2) to 3.43 (SSAP 9) with an overall mean score of 2.80. Similar opinions were held concerning module length; and, when asked to assess whether the package had helped them to understand the SSAPs, the mean score was 1.67 (with 1 representing 'a lot', and 5, 'not at all').

Asked whether they preferred PEER or lectures, 54% preferred PEER, and only 24% preferred lectures. When asked if they would like to have CBI packages like PEER available for other courses, 72% were enthusiastic about the idea and only 8% were against it.

The students reported two main problems in using the package: access to the computer lab where it was sited (44% of the students); and personal time (34%) – though, as they had not felt that there was excessive computing on the course, this was probably related to inconvenience (e.g. having to use the package 'after-hours') rather than overloading.

PEER has two types of questions, short and long. The short ones were completed by 88% of the students, whereas only 16% completed the long ones. It may not be appropriate to have questions of the longer variety in a package of this type (they require students to move back-and-forth between computer screens taking appropriate notes, in order to answer the questions raised) – certainly the students seemed to believe that they were of limited value.

General comments were invited. These were not unexpected (liking the ability to work at their own pace; finding PEER useful, textbooks not; 'good examples'; 'good idea'; 'very helpful'). There were only two critical comments: one student said that it was monotonous to use; another said that the mistakes in PEER caused problems.

On the subject of mistakes, there were not many errors in the modules and the students had been given a sheet with a list of eight before they started. These were mainly keyboarding errors (e.g. the wrong date in an example), and only one (in the SSAP 4 module) was central to the students' understanding of the material. Unfortunately, it became clear at the time of the class test that students were not consulting the error sheet they had been given, for virtually the whole class got a question wrong as a result of their following the error in the SSAP 4 module. This highlights how important it is that CBI material is correct before it is used by students for, once they see it on the computer, they take a lot of convincing that it is wrong. In addition, the fact that it took nine months before a revised release of the software was issued, correcting all the errors detected, clearly highlights a disadvantage of using proprietary CBI: errors cannot be instantly corrected.

Conclusions

The absence of any significant difference between the students' exam performance on the supplantively and supportively taught topics, suggests that supplantive use of this material may be a practical alternative to conventional teaching methods. However, this may be due to other factors (for example, topic difficulty) and the result should therefore be treated with some caution. Nevertheless, it does suggest that it would be worthwhile conducting further experiments involving the other modules and the other CBI packages.

The use of the material in a supportive way, does not appear justified if students are receiving adequate lower level tuition in these topics by other means. As this is how many users intend to adopt the material, it may be worthwhile reconsidering and, instead, experimenting with a supplantive approach. Similarly, tutorials are intended to be reinforcing experiences designed to build on base knowledge, and bring understanding. Replacing tutorials with supportive use of these PEER modules has not been shown to achieve that objective, and it may not therefore be productive to do so.

The package is extremely easy to use, the students enjoyed using it, and their confidence in using computers was enhanced as a result. The fact that the majority preferred it to lectures is further justification for supplantive adoption. However, one of the characteristics of CBI packages is that they allow students to work at their own pace and, to avoid slower students being disadvantaged, supplantive use should be supported, as far as is practical, by unlimited access to the software.

The critical view the students took of a course with no computing integration is not a message that should be ignored. For those who believe that there is no need for IT skills integration, a CBI package of this type may be an ideal way in which to satisfy both student IT expectations and to meet their demand for wider use of packages of this type.

The type of assessment used on the course was changed from that used previously, but this would have occurred whether or not the students had been using PEER. Use of the package did not require that the type of assessment be changed.

Finally, the study was a qualified success. While no significant enhancement occurred if the material was used supportively, evidence was found to support supplantive use. As a result, the exercise is to be expanded to concentrate on supplantive CBI, with students being given a week to study each PEER module, followed by a discursive seminar on the topic. It is hoped that this will enable them to raise their understanding beyond the level that they currently attain.

Acknowledgements

The author would like to thank two anonymous referees and Professors R.M.S. Wilson and G.R. Kaye for their comments on an earlier draft of this paper. Thanks are also due to Ailsa Nicholson of the CTI Centre for Accounting, Finance and Management at the University of East Anglia; and to PEER Training (UK) Limited and the Institute of Chartered Accountants of Scotland for their help and co-operation in the preparation of this article.

Appendix A - t-test results

	Hypothesis	n	mean	median	std.dev	t	p	Accept H ₀
1	time difference	34	0.230	0.025	0.151	1.49	0.15	✓
2	time difference	34	1.450	1.705	0.886	9.54	0.00	X
3 ^a	time dif 4-v-2	43	0.355	0.000	0.837	2.78	0.008	X
3 ^b	time dif 4-v-17	43	0.213	0.000	0.512	2.73	0.009	X
3 ^c	time dif 4-v-18	43	0.140	0.000	0.438	2.09	0.043	X
4 ^a	time dif 9-v-12	18	0.514	0.250	0.833	2.62	0.018	X
4 ^b	time dif 9-v-19	18	0.458	0.125	0.796	2.44	0.026	X
9	exam dif suppl-v-suppo	50	0.003	0.023	0.227	0.09	0.93	✓
10	exam suppl use-v-none	-	-	-	-	0.42	0.34	✓
11	exam suppl use-v-none	-	-	-	-	0.96	0.17	✓
14	confidence difference	50	0.240	0.000	0.657	2.58	0.006	X
15	literacy difference	50	0.540	0.500	0.734	5.20	0.000	X
16	comp dif Tax-v-FA2	47	1.170	1.000	0.963	8.33	0.000	X
17	comp dif MA3-v-FA2	47	0.043	0.000	0.415	0.70	0.49	✓
18	exam dif sample-v-all	50	0.497	0.514	0.139	1.46	0.15	✓
19	1st year dif sample-v-all	46	0.670	0.675	0.129	0.64	0.53	✓
20 ^a	exam dif suppo-v-both	34	0.513	0.529	0.133	0.68	0.50	✓
20 ^b	exam dif none-v-both	16	0.464	0.471	0.148	-0.89	0.39	✓
21 ^a	year 1 dif suppo-v-both	31	0.678	0.680	0.114	0.37	0.71	✓
21 ^b	year 1 dif none-v-both	15	0.655	0.660	0.159	-0.38	0.71	✓

Appendix B - examples of the questions in Questionnaire 3

- 1 Computer literacy is defined as "being able to use a computer effectively and efficiently when the need arises". How would you describe your computer literacy (CIRCLE ONE OF THE NUMBERS 1-5)

computer literate	1
more computer literate than <i>illiterate</i>	2
neither computer literate nor <i>illiterate</i>	3
more computer <i>illiterate</i> than literate	4
computer <i>illiterate</i>	5

- 2 In which of the following ways did you use *PEER* on each of the SSAPs? (CIRCLE ALL THOSE THAT APPLY IN EACH CASE)

	2-Policy	4-Grant	6-Extra	9-Stock	12-Depn	13-R&D	17-Post B.S.	18-Conting.	19-Inv. Props.
As a supplement to lectures [N/A = no lectures]	N/A	N/A	61	66	71	76	N/A	N/A	91
As your main source of information	52	57	62	67	72	77	82	87	92
To provide worked examples	53	58	63	68	73	78	83	88	93
As a means of revision	54	59	64	69	74	79	84	89	94
Other (<i>please specify</i>)	55	60	65	70	75	80	85	90	95

3 In respect of each of the *PEER* SSAP courses that you used, was the course on the individual SSAP (CIRCLE ONE NUMBER IN EACH COLUMN)

	2-Policy	4-Grant	6-Extra	9-Stock	12-Depn	13-R&D	17-Post B.S.	18-Conting.	19-Inv. Props.
very easy	97	103	109	115	121	127	133	139	145
easy	98	104	110	116	122	128	134	140	146
neither easy nor difficult	99	105	111	117	123	129	135	141	147
difficult	100	106	112	118	124	130	136	142	148
very difficult	101	107	113	119	125	131	137	143	149
did not study this <i>PEER</i> SSAP course	102	108	114	120	126	132	138	144	150

4 In respect of the *PEER* SSAP courses that you used, was the course on the individual SSAP (CIRCLE ONE NUMBER IN EACH COLUMN)

	2-Policy	4-Grant	6-Extra	9-Stock	12-Depn	13-R&D	17-Post B.S.	18-Conting.	19-Inv. Props.
too short	151	155	159	163	167	171	175	179	183
neither too short nor too long	152	156	160	164	168	172	176	180	184
too long	153	157	161	165	169	173	177	181	185
did not study this <i>PEER</i> SSAP course	154	158	162	166	170	174	178	182	186

5 Overall do you think the package helped you to understand the SSAPs? (CIRCLE ONE OF THE NUMBERS 187-191)

a lot	187
quite a lot	188
less than quite a lot but more than a little	189
a little	190
not at all	191

6 Would you like the *PEER* computer assisted learning approach to be used on other courses? ANSWER BY CIRCLING A NUMBER FROM 1 TO 5, WITH 5 INDICATING THE GREATEST DEGREE OF ENTHUSIASM FOR THE IDEA

My level of enthusiasm for the idea is 1 2 3 4 5 192

7 You studied SSAPs both in lectures and using the *PEER* package on the computer. Which method of learning do you prefer? (CIRCLE ONE OF THE NUMBERS 193-197)

strongly prefer computer	193
prefer computer	194
indifferent	195
prefer lectures	196
strongly prefer lectures	197

- 8 Overall, approximately how many hours did you spend with *PEER* on each of the SSAPs? Please take your time on this question and try and give as accurate an answer as possible. (ENTER THE NUMBER OF HOURS, USING FRACTIONS TO REPRESENT PART HOURS)

	Number of Hours
SSAP 2 - Policies	215
SSAP 4 - Grants	216
SSAP 6 - Extraordinary Items & Prior Year Adjustments	217
SSAP 9 - Stocks	218
SSAP 12 - Depreciation	219
SSAP 13 - Research and Development	220
SSAP 17 - Post Balance Sheet Events	221
SSAP 18 - Contingencies	222
SSAP 19 - Investment Properties	223

- 9 During the FA2 course, you received information on SSAPs from a number of sources. In respect of those SSAPs on which you received lectures (i.e. 6,9,12,13,19), please indicate the importance of each source in helping you to understand the SSAPs. (FOR EACH SOURCE, CIRCLE A NUMBER ON THE SCALE OF 1 TO 5, WITH 5 INDICATING IT WAS A MAJOR SOURCE OF INFORMATION.)

	Source Rating	Never Used the Source	
Lectures	1 2 3 4 5	225	224
<i>PEER</i>	1 2 3 4 5	227	226
Private Study	1 2 3 4 5	229	228
Text Book	1 2 3 4 5	231	230

- 10 Please indicate how important each of the following factors were in limiting your use of *PEER*. ANSWER BY CIRCLING A NUMBER FROM 1 TO 5, WITH 5 INDICATING THE FACTOR WAS A SERIOUS CONSTRAINT.

	Limiting Factor Rating	
Personal time available	1 2 3 4 5	233
Access to the microcomputers	1 2 3 4 5	234
Difficulty with software	1 2 3 4 5	235
Other (<i>Please specify</i>)	1 2 3 4 5	236

- 11 How confident are you at using computers? (CIRCLE ONE OF THE NUMBERS 237-241)

very confident	237
confident	238
neither confident nor apprehensive	239
apprehensive	240
very apprehensive	241

- 12 Why did you not make more use of *PEER*, particularly on those SSAPs other than 2,4,17, and 18?

- 13 Any general comments?

References

- American Accounting Association (1970) Report of the 1968–69 Committee on the role of the computer in accounting education. *The Accounting Review*, XLV (Supplement), 29–43.
- Ausubel, D.P. (1965) Cognitive structure and the facilitation of meaningful verbal learning. In *Readings in the Psychology of Cognition*, edited by R.C. Anderson and D.P. Ausubel, New York: Holt, Reinhart and Winston, Inc., 103–115.
- Bentz, W.G. (1979) Computer extended reciprocal allocation methods, *The Accounting Review*, LIV (3), July, 595–603.
- Bhaskar, K.N. (1982) Use of computers in accountancy courses. *Accounting and Business Research*, 12 (49), Winter, 3–10.
- Böer, G.B. and Livnat, J. (1990) Using expert systems to teach complex accounting issues. *Issues in Accounting Education*, 5 (1), Spring, 108–19.
- Borthick, A.F. and Clark, R.L. (1987) Research on computing in accounting education: opportunities and impediments. *Issues in Accounting Education*, 2 (2), Fall, 173–92.
- Boyd, G. (1988) The impact of society on educational technology. *The British Journal of Educational Technology*, 19 (2), 114–22.
- Chartered Association of Certified Accountants (1991) Accountancy education update. *ACCA Education Update*, Issue 20, May, 16–18.
- Collier, P.A., Kaye, G.R., Spaul, B.J. and Williams, B.C. (1990) The use of computers in accounting courses: a new perspective – a comment. *Accounting and Business Research*, 20 (80), Autumn, 353–4.
- Darby, J. (1991) Computer literacy or computers in teaching? *The CTISS File*, No 11, March, 48–9.
- Er, M.C. and Ng, A.C. (1989) The use of computers in accountancy courses: a new perspective. *Accounting and Business Research*, 19 (76), Autumn, 319–26.
- Fetters, M., McKenzie, J. and Callaghan, D. (1986) Does the computer hinder accounting education? An analysis of some empirical data. *Issues in Accounting Education*, 1 (1), Spring, 76–85.
- Friedman, M.E. (1981) The effect on achievement of using the computer as a problem-solving tool in the intermediate accounting course. *The Accounting Review*, LVI (1), January, 137–43.
- Gray, R.H. and Nicholson, A.H.S. (1990) Teaching introductory financial accounting: a systems approach with spreadsheets. *Account*, 2 (2), 22–29.
- Hartley, R. (1985) Using the computer for learning and teaching. In *New Directions in Educational Psychology 1. Learning and Teaching*, edited by N. Entwistle, Barcombe: The Falmer Press, pp. 317–31.
- Hawkins, D. and Allen, B. (1967) Computer assisted case analysis. *The Accounting Review*, XLII (4), October, 788–800.
- Heath, S. and Young, C. (1991) Reflections on CAL in the USA. *The CTSS File*, No 11, March, 33–6.
- Helmi, M.A. (1986) Integrating the microcomputer into accounting education – approaches and pitfalls. *Issues in Accounting Education*, 1 (1), Spring, 102–11.
- Izard, C.D. and Reeve, J.M. (1986) Electronic spreadsheet technology in the teaching of accounting and taxation – uses, limitations, and examples. *Issues in Accounting Education*, 4 (1), Spring, 161–75.
- Kaye, G.R. (1985) Teaching strategies in computers and accounting. *The British Accounting Review*, 17 (1), Spring, 22–36.
- Kaye, G.R. (1990) Summary of the state of computers in teaching accountancy, finance and business studies, *Account*, 2 (2), 2–4.
- Kaye, G.R. and Nicholson, A.H.S. (1991a) The current use of computers in teaching accounting, finance and business studies: a review of current practice. In *The Source Book*, edited by A.H.S. Nicholson, Norwich: The CTI Centre for Accounting, Finance and Management, University of East Anglia, pp. 147–61.
- Kaye, G.R. and Nicholson, A.H.S. (1991b) The current state of information technology in accounting education: a report from the CTI Centre for Accounting, Finance and Management. *Computers in Adult Education and Training*, 2 (2), 112–19.

- King, M. and McAulay, L. (1991) A standard costing knowledge base: building and using an expert system in management accounting education. *Issues in Accounting Education*, 6 (1), Spring, 97-111.
- King, R. and Whittaker, J. (1991) Integrating Computers into Accounting Courses. *Account*, 3 (2), 27-35.
- Leaver, B. (1991) Strategies for the use of IT in teaching. *Account*, 3 (2), 36-7.
- McCartan, A. (1990) An introduction to the computer literacy programme at the University of Durham. *The CTISS File*, No. 10, September, 40-3.
- McKeown, J.C. (1976) Computer-assisted instruction for elementary accounting. *The Accounting Review*, LI (1), January, 123-130.
- MacDonald, B., Atkin, R., Jenkins, D. and Kemmis, S. (1979) Computer-assisted learning: its educational potential. In *National Development Programme in Computer Assisted Learning: Final Report of the Director*, edited by R. Hooper, London: Council for Educational Technology, pp. 33-62.
- Neville, J. (1983) Teaching accountancy by remote control. *The Accountant's Magazine*, LXXXVII, (921), 97-9.
- Nicholson, A.H.S. and Mullings, C. (1991) Two reports on the computer literacy workshop held at the University of Durham 12/13 December 1990. *The CTISS File*, No 11, March, 50-3.
- Reynolds, M. (1991) Observer's report on the Integration of Information Technology in Accounting Education Workshop at the Issues in Accounting Education Conference, Nottingham Business School, 20 September 1990. *Account*, 3 (1), 35-8.
- Ryan, R.J. and Simpson, S.M. (1988) Computer-aided instruction for *Ab Initio* teaching in accounting: *The British Accounting Review*, 20 (2), August, 110-30.
- Sangster, A. and Wilson, R.A. (1991) Knowledge-based learning within the accounting curriculum. *The British Accounting Review*, 23 (3), September, 243-261.
- Seddon, P. (1987) Computing in the undergraduate curriculum. *The British Accounting Review*, 19 (3), December, 267-76.
- Shelton, R. and Cairns, D. (1990) Experience and futures with Hypercard. *The CTISS File*, No 9, February, 11-3.
- Somekh, B. (1990) The evaluation of teaching with computers. *The CTISS File*, No 10, September, 32-9.
- Williams, B.C. (1991) The impact of basic accounting concepts and education: an overview. In *Accounting and IT: The Impact of Information Technology*, edited by B.J. Spaul and B.C. Williams, London: Chapman and Hall, pp 1-16.

4. Rawlinson, D. and Sangster, A. (1992), *EQL Bookkeeping - the demise of the lecturer?*, In the selected proceedings from the 3rd Annual CTI-AFM Conference, Bradford, April 1992, Williams, B C and Nicholson, A H S (eds.), pp. 31-40. [30%]

EQL Bookkeeping - The Demise of the Lecturer?

*David Rawlinson & Alan Sangster
Department of Accountancy University of Aberdeen*

Abstract

This paper reports on the first year's experience of the use of EQL Bookkeeping in the accountancy curriculum at Aberdeen University. It includes a commentary on the package; a summary of the way in which the material was previously taught; a description of the criteria adopted when allocating individual students to compulsory or non-compulsory use of the software; details of the monitoring devices adopted; and an analysis of student performance post-EQL compared with pre-EQL.

1. Introduction

In late 1990, the Institute of Chartered Accountants of Scotland released the EQL Bookkeeping computer assisted learning package. By April 1992, it was in use in around 200 organisations. 49% of the copies sold were to educational institutions, including all the Scottish university and polytechnic accountancy departments. Literally thousands of students are using the package - for example, over 700 had used it by December 1991 at one English polytechnic alone. ¹ While some adopters are attempting to evaluate the effectiveness and acceptability of the package (see, for example, Gallagher, 1991 ²), little evidence is currently available as to how best to integrate it into the curriculum.

When Aberdeen University introduced EQL Bookkeeping for the first time in autumn 1991, the process was monitored and student performance and attitude recorded and evaluated. No significant change in the exam performance of students as a result of the use of the EQL Bookkeeping program was found; and the overall experience of the first year's use of the package has ensured that it will have a continuing role to play in the teaching of bookkeeping at Aberdeen.

2. EQL Bookkeeping

2.1 Introduction

EQL is an elementary bookkeeping program written and distributed by the Institute of Chartered Accountants of Scotland. It is designed for use as the main or sole teaching medium for the subject but could also be used in a supporting role for other methods of teaching. It is divided into 15 lessons which start with double entry and conclude with incomplete records.

2.2 Assessment of the package

No two students will be fully in agreement as to what constitutes an ideal learning experience. While there will inevitably be perceived strengths and weaknesses in any package, the overall reaction of the students was positive (see Table 1). Similarly,

each teacher will have his or her own idea as to the best way in which to teach a course or what to include in it.

TABLE 1: STUDENT OPINION OF THE EFFECTIVENESS OF EQL BOOKKEEPING

EXCELLENT	GOOD 20.7%	REASONABLE 72.4%	POOR	VERY POOR 6.9%
------------------	----------------------	----------------------------	-------------	--------------------------

2.3 Some Strengths of EQL Bookkeeping

- a) It is easy to use.
- b) It has, on the whole, clear explanations.
- c) It has many worked examples for the students to follow and questions for them to attempt.
- d) The topics covered should be suitable for most elementary bookkeeping courses.
- e) It has all the usual advantages claimed for a computer program of this nature, for example the teaching is standardised, the students can work at their own pace, and they can gain immediate feedback on their progress through the questions and answers.
- f) Optional assessment modules are available enabling the teacher to monitor student progress.
- g) If used supplantively (i.e. in place of staff contact with students), the package could help relieve some of the burden of increasing student numbers and student/staff ratios anticipated over the remainder of the decade.

2.4 Some weaknesses of EQL Bookkeeping

- i) No printed details of the contents are provided (for example, this could have been in the form of a book containing all the text screens). Referencing and revision are more difficult as a result.
- ii) The content of the package is fixed and can not adjusted by the teacher. Teaching has therefore to be modified to fit in with the software.
- iii) While topics for inclusion in a basic bookkeeping course and the order in which they should be treated are points for debate, VAT does seem to be introduced too early in the course (at lesson 6), and is then allowed to confuse subsequent material.

- iv) No explanation of errors is given except in the form of the correct answer.
- v) It is possible for students to skip over the exercises without working through them.
- vi) Most topics are clearly explained but there are exceptions. Stock, for example, seems to cause some problems. It is dealt with in three different lessons and contains, in Lesson 15 (Incomplete Records), the requirement to use three stock accounts:

Opening Stock (profit and loss account)
 Closing Stock (profit and loss account)
 Stock (balance sheet account)

Hardly an ideal approach in a package of this type.

- vii) The program consists of 15 lessons. Allowing one hour per lesson and assuming a class of 100 students and a laboratory with 12 PCs, this requires computer laboratory time of 125 hours. In some institutions, this may be difficult to provide - particularly on an 'open access' (i.e. free access outside timetabled hours) basis, which has been found to be desirable with other CAL packages if the 'students work at their own pace' advantage is to be attained.³
- viii) If used supportively (i.e. to support the series of lectures and workshops) rather than supplantively (i.e. to replace them), the result will be an additional investment in staff time instead of a saving.

3. Bookkeeping at Aberdeen

The first year Financial Accounting course at Aberdeen University provides a general introduction to external financial reporting by businesses and other organisations. The balance sheet and profit and loss account have a key role to play, but more with regard to interpretation, limitations etc., rather than with events leading up to their preparation. Although "recording of transactions using double entry bookkeeping" forms part of the syllabus, it has always received minimal attention, perhaps suffering from being the preserve of the technician rather than the academic.

Somewhat predictably, students found this part of the course difficult to understand; and anything but the easiest of adjustments to a trial balance, almost an impossibility. A worrying factor of a slightly different nature was the impression, coming from the professional firms, that our honours graduates, for all their in depth knowledge of things esoteric, could not tell a "debit" from a "credit".

In response to these prompts, an elementary bookkeeping course was introduced in 1978 to run concurrently with the financial accounting course. Initially this was

neither compulsory nor examinable and, perhaps not surprisingly, nor was it very successful. It was helpful when dealing with the basic accounting equation, year end adjustments and the like, but when topics with less immediate relevance to their financial accounting course came up for discussion, students quickly learned to vote with their feet.

The next stage in the development was designed to demonstrate the importance of the course. In 1988, it was made both compulsory and examinable. This coincided with the modularisation of courses at Aberdeen and the first year courses, required for an accountancy student, then became financial accounting, bookkeeping, and management accounting.

4. Bookkeeping Immediately pre EQL

The bookkeeping course was designed to assist students who had problems with the bookkeeping elements of the financial accountancy course and to provide them all with information on more advanced bookkeeping topics. Because some of the students had previously studied accountancy, the more elementary part of the course was not suitable for them. In recent years there has been a significant increase in the proportion of students in this category (see Table 2).

TABLE 2: ENTRANTS TO FIRST YEAR COURSE

	1980/81	1985/86	1990/91	1991/92
BEGINNERS	52.8%	58.9%	31.3%	20.9%
EXPERIENCED	47.2%	41.1%	68.7%	79.1%

The course consisted of one lecture and one workshop held weekly over a 20 week period. The first part of the course was not compulsory for students who had previously studied accountancy, and they attended on average approximately 20% of that part of the lecture course.

5. Reasons for Introducing EQL Bookkeeping

5.1 To provide Experienced students with Revision Material

It was felt that the policy of exempting experienced students from the first part of the course was not entirely satisfactory because of the varying levels of previous experience and ability. Another factor to be considered was the increasing number of mature students whose knowledge might have deteriorated.

It provides the experienced student with the opportunity to work through the required material at his or her own pace and its use helps each student, whatever the previous level achieved, to arrive at the same place by the end of the course.

5.2 To Improve the performance of the Beginners

The exam results of students with no previous accountancy experience compared unfavourably with the other students (see Table 3). Although in some respects this was not surprising it was, nevertheless, felt that it should be possible to narrow the gap. The use of EQL, as a back up to the lecture course, is to provide beginners with revision material in a format which will maintain their interest.

TABLE 3: STUDENT PERFORMANCE (note: the numbers vary as not all students sat each test and exam)

1990/91	EXPERIENCED			BEGINNERS		
	PASS	FAIL	AVERAGE MARK	PASS	FAIL	AVERAGE MARK
DEGREE:						
1st attempt	43	3	77.4%	13	7	57.2%
2nd attempt	2	1	54.6%	3	5	46.4%
TESTS:						
mid-session	35	10	63.3%	10	7	48.6%
pre-session	22	19	48.4%	-	-	-
1991/92						
DEGREE:						
1st attempt	46	3	67.3%	10	0	59.1%
TESTS:						
mid-session	34	13	62.0%	7	5	50.7%
pre-session	23	23	52.8%	-	-	-

5.3 To Investigate the Value of Different Teaching Methods

Improvements would normally be expected to accrue from taking a fresh look at how a subject is taught. EQL provided an excellent opportunity to do this and it was hoped to improve student standards in the subject by this restructuring of the course.

6. Integration of EQL into the Bookkeeping Course

EQL Bookkeeping was used in a supportive role and the time honoured methods of lecturing and tutoring were retained. The 1991/92 class was split into two groups: those who had previously studied accountancy - the "experienced" students - and those who had not - the "beginners".

For the beginners, the course consisted of the same series of lectures and workshops which operated in previous years. A one hour weekly computer lab was available for them to use EQL. (They also had open access to the computer lab at other times, including evenings and weekends.) Attendance at the lectures and workshops was required, but the use of EQL was at the students' discretion.

The experienced students used EQL to fill any gaps in their knowledge and revise the remaining topics. Attendance at the weekly computer labs provided for them was compulsory and, as with the beginners, access to the lab was available at other times if required. They were also invited to attend lectures on any topics which were causing them problems.

7. Assessment of the Usefulness of EQL Bookkeeping

7.1 Introduction

The previous year's students were used as the experimental control: they had sat the same tests and followed a course which was identical to the experimental groups, with the exception that they did not have any access to EQL. The only other difference between the two years was that previously experienced students attended approximately 20% of the lectures, whereas in the experimental year this was less than 5%. Comparison of the year groups' performances on a bookkeeping test given prior to the start of each year's course did not indicate any significant difference between the two year groups in ability (see Figures 1 and 2). A number of comparisons can therefore be made from which opinions can be formed. [The experimental year students will be referred to as 1991; and the previous year's students, as 1990.]

FIGURE 1: PRE-COURSE TEST MARKS (max 25) 1990/91

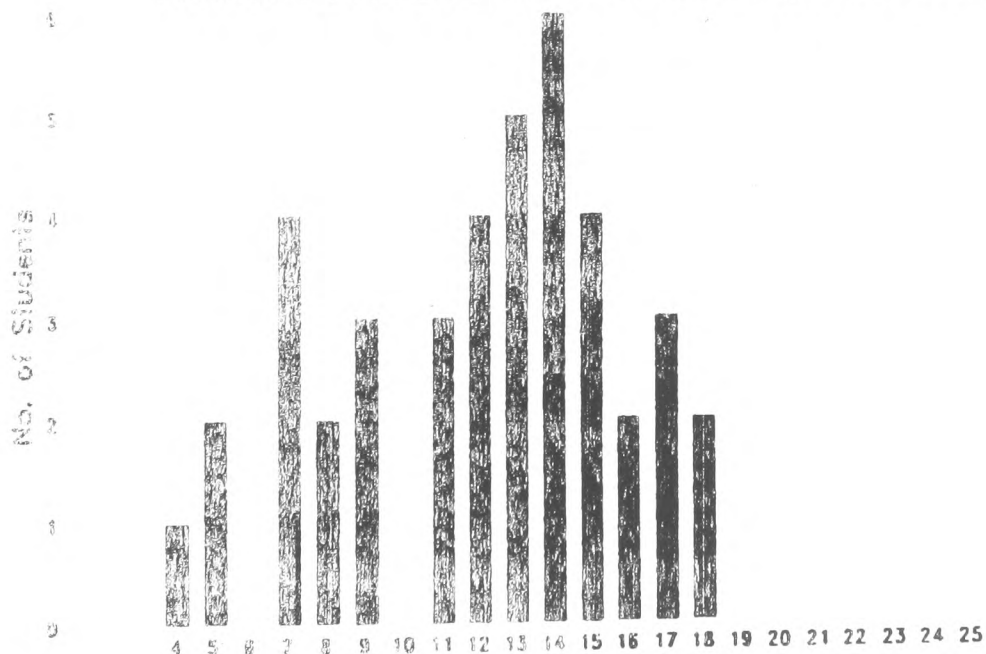
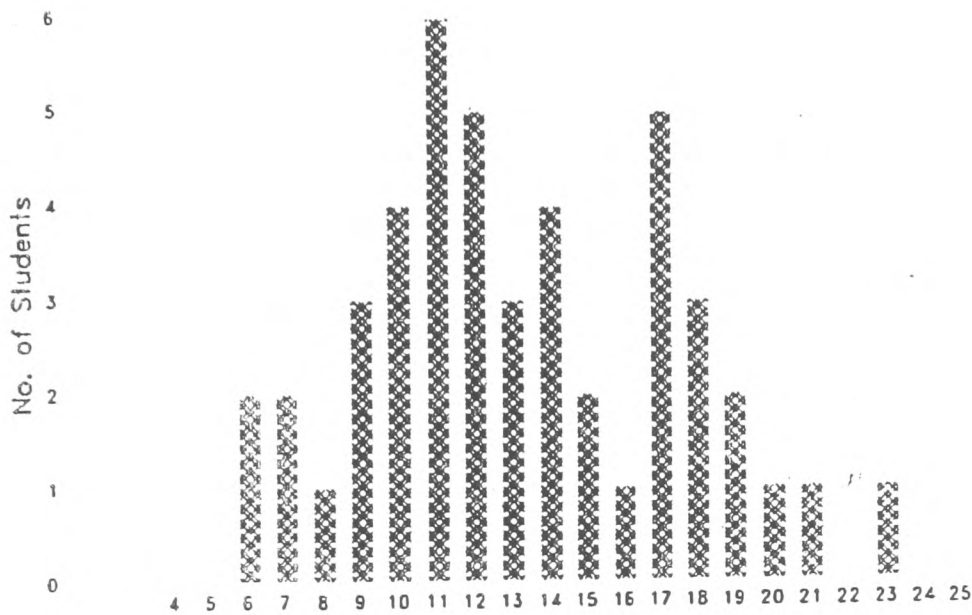


FIGURE 2: PRE-COURSE TEST MARKS (max 25) 1991/92



7.2 Experienced Students' Exam and Test Results.

As can be seen from Table 2, in the mid session test, the average marks for the two years were very similar: 1991 was 1.3% lower at 62%, compared with 1990's 63.3%.

[Unfortunately, it proved impossible to use the same final exam paper. Nevertheless, the same number of students (three) failed in both 1991 (of 49 students who sat the exam) and 1990 (of 46).]

7.3 Beginners' Exam and Test Results.

The main area where improvement was hoped for, was in the pass rate of the beginners group. Table 2 reveals that this rose from 65% in 1990 to 100% in 1991. (However, this result is subject to the limitation that there were only 20 students in the 1990 beginners group, and only 10 in 1991.)

7.4 Attendance.

Initially, it was intended that beginners should only attend the lectures and workshops and not have the opportunity to use EQL. However, as this would have denied them a possibly useful learning experience, it was not adopted. Table 4 shows that the fact that the use of EQL was voluntary for this group proved irrelevant - they had a 91% computer lab attendance (compared with a 97% attendance by the experienced group).

TABLE 4: STUDENT ATTENDANCE

	WORKSHOPS	COMPUTER LAB
BEGINNERS	87.5%	91.3%
EXPERIENCED	3.6%	97.1%

7.5 Time spent on EQL

Table 5 summarises the time spent by the students using EQL. Of the 15 lessons, the experienced students' overall mean completion rate was 14.4, spending an average of 46.51 minutes per lesson and a total time of 11.15 hours. For the beginners, these were 13.6, 51.4 and 11.65 respectively. The 15 hours which had been timetabled for EQL was adequate for all but two students and the time spent on the lessons did not differ markedly. No correlation was found between the time spent on EQL and performance in the tests. [Interestingly, not only did the student who spent the least time on EQL (4 hours, 55 minutes) score the highest mark in the degree exam (100%), but the student who spent the most time (36 hours, 30 minutes) scored the lowest mark on the exam (30%)!; and neither of them were beginners.]

TABLE 5: TIME SPENT USING EQL BOOKKEEPING

	RESPONSES	LESSONS COMPLETED	HOURS TAKEN	AVERAGE TIME PER LESSON
BEGINNERS	5	12 to 15	7 to 15	51.40 minutes
EXPERIENCED	43	12 to 15	5 to 36	46.51 minutes

7.6 Significance of the Results

Comparing results between the two year groups in the two tests and the exam (pre-session, mid term and first degree attempt), there was no significant difference, at the 95% confidence level, in the performance of the two years. Apart from the introduction of EQL, the only teaching-related difference between the two years was that the 1991 experienced students reduced their attendance at lectures by 75% compared to those in 1990.

In both years, experienced students improved their performance significantly from their pre-session test to both the mid-term test and the final exam; and the beginners improved significantly between the mid-term test and the final exam. As this applied to both years, it can only be concluded that some form of instruction was worthwhile. Whether that instruction should take the form of EQL or lectures was not determined by the results of this experiment; though the results do suggest that EQL could safely be substituted for the lectures previously attended.

In both years, the experienced students maintained a significant superiority over the beginners through both the mid-term test and the final examination.

8. Students' Opinions

Students were given a questionnaire to complete at the end of the course. Among the questions asked, they were invited to give their overall opinion of the EQL program and, as was shown in Table 1, the overwhelming response was that it was only "reasonable". Yet (as shown in Table 5) they were not deterred from using it and working through all the lessons.

They were also asked for their views on the time spent on the various elements of the course. As can be seen in Table 6, the majority (65.5%) thought the time spent on EQL was "just right"; but there were mixed feelings about the need to have a supporting programme of lectures and workshops.

TABLE 6: STUDENT OPINION ABOUT THE TIME SPENT UNDER EACH TUITION MODE

	TOO LITTLE	JUST RIGHT	TOO MUCH
LECTURES	63.0%	37.0%	-
WORKSHOPS	48.0%	52.0%	-
EQL		65.5%	34.5%
BOOKKEEPING			

They also felt that the EQL program was easy to understand and this is supported by the few areas of difficulty which they encountered. Table 7 shows that only four topics presented problems to more than one student.

TABLE 7: PROBLEM AREAS ENCOUNTERED BY STUDENTS USING EQL BOOKKEEPING

	STUDENTS FINDING PROBLEMS
VAT	10
ACCRUALS AND PREPAYMENTS	5
BANK RECONCILIATIONS	3
WAGES	3
OTHERS	8

9. Conclusions

The lack of any significant improvement in the results between the two years does not mean that the introduction of EQL was a failure. For those students with previous experience (an increasing proportion each year), EQL was an efficient way of ensuring that they all covered the required material, allowing them to do so at

their own pace, and in a manner which maintained their interest. For the beginners, EQL was, at the very least, useful revision material; and, for future years, could provide the core of the material for the course with backup support in the form of workshops or tutorials.

As an experiment into the potential use of material of this type, it suggests that EQL may be a viable alternative to the rote delivery medium of the lecture - the performance of the experienced students who were using EQL in place of lectures rose significantly over the course, as it had done when lecture attendance was first made compulsory.

References

1. Gallagher, D. *Evaluation of Computer Aided Learning*. Account, Volume 3, No. 2, 1991, pp. 38-39.
2. Sangster, A. *Computer-based Instruction in Accounting Education*. Accounting Education, Volume 1, No. 1, 1992, pp. 13-32.
3. Short, T. *The Assessment of Student Learning from Computer Based Training Material*. Paper presented at the Integration of Computer Based Training (CBT) Materials in Higher Education Conference, University of Bradford Management Centre, December 1991.

5. Sangster, A. (1996), *Objective tests, learning to learn, and learning styles*, *Accounting Education, an international journal*, Vol. 5 No. 2, pp. 131-46.

Objective tests, learning to learn and learning styles

ALAN SANGSTER*

Division of Accounting and Finance, The Queen's University of Belfast

Received April 1995

Revised August 1995

Accepted October 1995

Abstract

This paper describes the 5 year adjustment process followed in one university when formative objective test (OT)-based assessment was introduced into a second level course in order to support the student-centred use of a proprietary CAL package. It then compares the performance and background characteristics of students on two of those years. It finds the OTs identify a different ranking among the students compared to traditional essay-based assessment, that *learning styles* have an impact upon performance on OTs, finds evidence to suggest that students with low levels of *learning styles* may be disadvantaged when faced with a need to change their approach to learning and concludes that any explanatory study of student performance should include *learning styles* as an independent variable.

Keywords: assessment, formative assessment, summative assessment, objective test, learning styles

Introduction

Teachers in higher education are slowly accepting the fact that they have to become more professional in their approach to teaching, matching their professionalism in research ... There is also a growing recognition that the technological media have the potential to improve students' learning, or at least teaching efficiency, and university teachers are looking for ways of increasing their understanding of what can be done with the new media, and how to do it (Laurillard, 1993, p. i).

Assessment has become a major topic of interest in education during the last few years. This interest has led to the launch of specialist journals (for example, *Assessment in Education: Principles, Policy & Practice* by Carfax Publishing) and clearing-houses dedicated to assessment, including the Educational Resource Information Center (ERIC) *Clearinghouse on Assessment and Evaluation* (available on world wide web at http://www.cua.edu/www/eric_ae/). There are a number of research centres concerned with assessment, including the Center for Research on Evaluation, Standards, and Student Testing (CRSST) at the University of California at Los Angeles, USA and the TLTP Project, Assessment of Learning through Technology for Efficiency and Rigour (ALTER) at the UK Universities and Colleges Staff Development Agency. *Internet* discussion lists on education carry considerable correspondence and debate on assessment.

Studies have been conducted into the differences between alternative methods of assess-

*Address for correspondence, Alan Sangster, Division of Accounting and Finance, The Queen's University of Belfast, Belfast BT7 1NN, Northern Ireland, UK (a.sangster@qub.ac.uk).

ment, for example the Institute of Chartered Accountants in England and Wales (ICAEW) sponsored a study that compared many different forms of assessment (Hoskin and Steele, 1991). A large number of academic papers have been written on different aspects of assessment and, in the case of accounting education in the UK, the Board of Accreditation of Educational Courses (BAEC) is currently placing considerable emphasis upon the forms, integrity and contribution of summative assessment, as modularization in conjunction with shifts from traditional end-of-course examination towards a combination of assessed work and (a lesser) end-of course examination have combined to present a very different picture of assessment in the mid-1990s to that which existed even at the start of the decade, never mind 10 or 15 years earlier (Brown and Pendlebury, 1992; Entwistle *et al.*, 1992).

A change in assessment method may shift the focus of the knowledge, skills, understanding and competencies that is being assessed (CNAAC, 1989). As a result, any such change in assessment method will not necessarily lead to the same conclusion as previously held concerning a student's abilities. In addition, students take their cues from what is assessed, not from what is said to them (Brown and Pendlebury, 1992, p. 7). As a result, any alteration in assessment methods must take account of the impact of the change upon the approach of students to learning. For example, a shift from essays to multiple-choice questions will encourage surface learning in place of a deeper approach (Entwistle *et al.*, 1992). Whether such a shift in the approach of students would be appropriate will depend upon the nature of the material being covered, the manner in which the subject material is being presented and the level of the course.

Furthermore, different assessment methods have different characteristics and different levels of suitability for assessing performance. For example, while it may be relatively easy to assess students at any specific level of Bloom's taxonomy through a viva or through minor alteration of the wording of an essay title, it may be a very significant task to assess any further than the lower levels of the taxonomy using objective tests (OTs) (Brown and Pendlebury, 1992, p. 47).

In addition to the movement away from traditional essay-based assessment, there is an increasing emphasis in higher education towards student-centred, flexible learning as a means of encouraging students to take control of their own learning (Bull, 1993a). The upsurge in the availability and use of technology-based course materials, both for learning and for assessment (Bull, 1993b), has both fuelled and supported this movement, as have the UK's *Enterprise in Higher Education Initiative* and the *Teaching and Learning Technology Programme*.

There is, therefore, a vast difference between the educational environment as it exists today and that which existed even a few years ago. Many tutors are changing their approach to teaching and their approach to assessment. However, it is important that such changes are carefully considered. In their research for the ICAEW, Hoskin and Steele (1991, p. 17) recommended that changes in assessment should concentrate upon well-designed and carefully evaluated innovation. This concern was spelt out more specifically by Laurillard (1993, pp. 217-18) in the context of adoption of new technology in education:

New ... methods are too frequently introduced to students on an experimental pilot basis without being properly integrated into their teaching. Students therefore see them as peripheral to the real teaching, and invest less effort in them than they otherwise would. The only real test of any learning material is its use under normal course conditions. This means it must be integrated with other methods, the teacher

must build on the work done and follow it through, and most important, the work the students do on the materials must be assessed. This may require new standards to be set... It may be possible for the computer to assess the work, in which case the teacher has to monitor its performance... Academics ignorant of new technology are in danger of being too easily impressed by the results of a few key presses... Part of the point of new teaching methods is that they change the nature of learning, and of what students are able to do. It follows that the teachers then have the task of rethinking the assessment of what they do. Whatever changes are decided upon... it is vital that they are communicated to students clearly.

A review of the literature on assessment that has appeared in the 1992, 1993, and 1994 volumes of three of the leading accounting education journals (*Accounting Education*, *Issues in Accounting Education*, and *Journal of Accounting Education*) reveals an emphasis on the use of assessment for summative purposes – to award a mark for performance that contributes towards the final mark for the course. Virtually none have been concerned with the use of assessment for formative purposes – to assist students in assessing their progress and pinpointing where they have weaknesses and strengths (and where instructors may have need to alter their approach and even correct some generally held misbelief). Yet, it is in the context of formative assessment that accounting educators are both less experienced and in need of the greater guidance concerning what forms it may take, how it should be administered and what the advantages and disadvantages of it may be.

The next part of this paper describes the 5 year transformation process followed in one university when, in order to support the student-centred use of a proprietary Computer Assisted Learning (CAL) package, formative OT-based assessment was introduced into a second level course on accounting standards. There then follows some analysis of the student performance, along with a consideration of background data and of *learning styles*.

Background – the 5 year transformation process

In 1990, the CAL package *PEER Accounting Standards* was purchased for use in a 15 hour second level course on accounting standards. Prior to the 1990–1991 academic year, students on the course were taught using a traditional lecture plus tutorial approach. The CAL package was used for the first time in the second semester of the 1990–1991 session and was accompanied by a series of changes over that and the following 4 years in course structure,

Table 1 Changing structure of the course 1989–1990 to 1994–1995

Year	Number of standards	Number of standards taught by CAL	Number of lectures	Number of tutorials	Number of computer laboratories
0, 1989–1990	5	0	12	3	0
1, 1990–1991	9	4	9	0	6
2, 1991–1992	10	6	8	5	2
3, 1992–1993	10	6	8	5	2
4, 1993–1994	10	6	8	5	2
5, 1994–1995	10	6	8	5	2

Table 2 Changing forms of assessment of the course 1989–1990 to 1994–1995

Year	Paper-based		Computer-based	
	Formative mid-course test	Summative end of course examination	Formative during course tests	Summative end of course examination
0, 1989–1990	None	Mixture of computation and essay Qs	None	None
1, 1990–1991	OT	17Q-OT(50%) + essay (50% – compulsory)	None	None
2, 1991–1992	None	21Q-OT(50%) + essay (50% – compulsory)	Five OTs(40% minimum on each; 50% average)	None
3, 1992–1993	None	Only essay (50% – compulsory)	Five OTs (40% minimum on each)	21Q-OT(50%)
4, 1993–1994	None	Only essay (50% – compulsory)	Five OTs (40% minimum on each)	21Q-OT(50%)
5, 1994–1995	None	Only essay (50% – optional)	Five OTs (40% minimum on each)	21Q-OT (50%)

content, and assessment. The changes in course structure and content are summarized in Table 1.

As shown in the table, the content of the course altered from five accounting standards taught using traditional methods in 1989–1990, to the 1991–1992 onwards mix of ten accounting standards, four of which were taught using lectures and six of which were taught through CAL.

Table 2 outlines how assessment on the course changed from 1989–1990 (when there was no formative assessment, only a traditional final examination-based summative assessment) to 1994–1995 when there were five during-course formative OTs, an end of course summative OT that carried 50% of the grade for the course and an end of course essay-based summative assessment that carried the other 50% of the grade.

In more detail, the process of changes adopted over the 5 years was as follows.

Year 1 (1990–1991)

Previously, five accounting standards (standards) had been taught on the course. In 1990–1991, a further four were added, making nine in total. Students were directed towards the *PEER* material on four of the standards and no material on those standards was included in the lecture programme. The time previously allocated to tutorials, plus three of the lecture hours were reallocated for computer laboratory access – as a result, there were nine lectures (in place of 12) and six computer laboratories (in place of three tutorials and three lectures).

Two changes were made in the assessment. A mid-course paper-based formative OT was set on the three standards the students were scheduled to have covered on *PEER* by that stage and 50% (nominally 30 minutes) of the final paper-based examination assessment on accounting standards comprised 17 objective test questions covering all nine standards.

Year 2

No statistically significant difference was found between the 1990–1991 students' examination performance on the standards dealt with in the self-study *PEER* modules and on the traditionally delivered topics. In addition, the students indicated they preferred the student-centred *PEER* approach to the traditional lecture delivery (Sangster, 1992). As a result, further changes were made in 1991–1992. The number of accounting standards covered on the course was increased by one to ten. Of these, four were delivered in lectures, one less than in 1990–1991; the students were directed towards *PEER* for the other six, an increase of two over 1990–1991. Students were given eight lectures and seven tutorials/computer laboratories. Thus, compared with the previous year, while the number of student contact hours (15) was the same as before, the nature of the contact had changed, there being one less lecture (eight in place of nine), two supervised computer laboratories (where previously there had been six) and five tutorials (where there had been none).

Other changes involved the assessment. In place of the single mid-course paper-based formative OT, there were five formative 10 minute computer-based OTs, one at the start of each tutorial. These tests contained anything from 25 to 40 questions on the standard the students were most recently scheduled to have studied using *PEER*. (In the first test, two standards were covered.) After the test had been completed, the remainder of the tutorial adopted a more traditional approach, involving a discussion of the standard(s) the students had just been tested upon, using the textbook *Workbook of Accounting Standards* (Sangster, 1991) as a source for discussion points.

In order to be permitted to sit the final examination, the students were required to attain an average mark of 50% over the five tests, subject to achieving a minimum of 40% on each one. Students who failed to reach the required standard on a test could retake it as often as they wished until they achieved the required mark. The retake was done in their own time and was not supervised. Retakes that scored more than 40% were restricted to 40% for the purposes of calculating a student's overall average.

The tests were conducted using *Question Mark* and the results were saved to floppy discs from where they were collated following the final tutorial of the week, for analysis and to monitor progress. The students received immediate feedback at the end of each test concerning their overall performance, but no indication of how they had performed on individual questions. Once everyone had achieved the necessary level of performance on a test, it was released for general use in a 'practice' format that provided immediate feedback after each question, including the correct answer and an explanation. In addition, 'practice' tests were made available on each of the other four standards once the lectures on it had been presented.

The OT in the 1991–1992 final examination had 21 parts, an increase of four over the 1990–1991 test. Again, it represented 50% (nominally 30 minutes) of the final examination on accounting standards.

Year 3

The following year, 1992–1993, as a result of the perceived success (in terms of the students' final examination performance) of the move to integrate regular formative OTs, a further alteration was made to the course. In place of the paper-based OT in the final summative examination, a computer-based OT was set at the end of the course, approximately 1 week after the last formative test. The requirement to pass the formative tests was linked to this end-of-course summative OT – students had to achieve the required standard or they would be refused permission to sit the test. However, while there was still a requirement to achieve

40% in each test, the requirement for a 50% average was dropped. There was also a change in the way the results were being recorded: floppy discs were discontinued and the results were written directly to the network file server, from where they were downloaded for analysis immediately the last tutorial had finished. The format of the course was otherwise unchanged.

Two computer laboratories were used for the summative end of course computer-based test and the class was split into four, with two groups in the laboratories for the test, while the others waited outside. After both the first two groups had completed the test, they were led out of the laboratories and out of the building, using an exit that took them away from the waiting students, who then entered the laboratories and took the test. Two laboratories were used, rather than four, because of resource constraints. This summative objective test contained the same questions as had been used in the paper-based equivalent section of the previous year's examination. The questions had not been allowed into the public domain following that examination. However, the students were allowed only 20 minutes for the test, as compared with the nominal 30 minutes in the paper-based 1991–1992 examination.

Year 4

No changes were made to the course in 1993–1994.

Year 5

In 1994–1995 the same process was followed, except that the groups into which the students were placed met on different days of the week. Previously they had all met, one after the other, on a Thursday morning. This change necessitated that a separate (but identical) test file was created for each group where previously they had all used the same test file. Despite the staggering of the tests through the week, there was no evidence of anyone having been shown the test or told about it by someone in a group that had already been tested. A change was also made in the sequence of activity during the tutorials. In place of the test being at the start, followed by a discussion of the material, the discussion was moved to the beginning of each tutorial and the test was done in the last 10 minutes. This would have been expected to have led to an improved performance on the tests compared with previous years.

The format of the formal examination was changed and included only one *optional* essay

Table 3 Performance on the formative computer-based OTs 1991–1992 to 1994–1995

Year	OT 1		OT 2		OT 3		OT 4		OT 5		Results saved to
	Average (%)	Retake (%)	Average (%)	Retake (%)	Average (%)	Retake (%)	Average (%)	Retake (%)	Average (%)	Retake (%)	
2, 1991–1992	55	18	73	none	40	56	38	50	61	1	Floppy discs
3, 1992–1993	? ^a	15	71	3	44	35	40	43	39	54	Server
4, 1993–1994	65	5	74	2	44	35	50	16	38	60	Server
5, 1994–1995	50	27	73	1	45	38	54	18	40	42	Server

^aThe data for this test was lost due to problems with the network server.

question on the accounting standards. (The accounting standards course, being of 15 hours, was actually 50% of the module being assessed. The remainder of the examination was on unrelated financial accounting topics and the students had previously been *required* to answer one of two essays on accounting standards.) As in previous years, the essay question was worth one-third of the marks available in the written examination (which counted towards 75% of the overall assessment, the OT representing the other 25%). The overall effect of this change was that students could elect to be assessed on their knowledge and understanding of the accounting standards solely on the basis of the summative OT, and 85% did so.

Student performance over the 5 year period

Table 3 presents the students' performance over the period 1991–1992 through 1994–1995 on each of the five formative OT-based assessments. (The OTs were identical throughout this period.)

Table 4 shows the students' performance on the summative assessment over the 5 years 1990–1991 through 1994–1995. The 'fail' columns show the percentage of students who achieved a grade of below 40% on that item of assessment.

Problems that arose

Very few problems were encountered during the 5 year transition process. The only two that caused difficulty were resistance from colleagues in 1990–1991 who found it hard to accept that students could answer 17 OT questions in 30 minutes, and data loss mainly due to computer network glitches.

The resistance from colleagues was overcome by showing them the performance of the students over the five formative tests in 1991–1992, when between 25 and 40 OT questions were being answered in 10 minutes.

Overcoming the problems with data storage was more difficult. When *Question Mark* was first used in 1991–1992, the students' test scores were saved to floppy discs. The discs all then had to be fed into a PC and the answer files downloaded, one at a time, into *Question Mark*. This took approximately 30 minutes and there was always the risk that a disc may have been corrupted or that a student had removed the disc prior to the answers being stored. In addition, retakes could only be checked if a student brought a disc to the tutor. However, no results were lost in that year. Nevertheless, in view of the complexity of the data retrieval process and because of the ease with which retake and practice use of the tests could be monitored, data storage shifted from floppy disc to the computer network file server in 1992–1993.

This move was an immediate disaster – scores for the first test were lost as a result of a problem with the file server and the only record of performance was a 'pass/fail' list kept by the tutor. A similar problem arose with the second test where over one-third of the students' data was 'lost'. However, data for 40 students was stored and, as before, 'pass/fail' had been recorded for the entire class. By the start of the third test, the problems were largely rectified. However, a few results were lost in the third and fourth tests because of problems with multiple simultaneous saves to the same file on the server. (This had been identified as a problem in the second test and explains at least part of the data loss on that occasion.) Despite repeated reminders of the risk of this occurring and of what to do if it did, a few students

Table 4 Performance on the summative assessment 1990–1991 to 1994–1995

Year	Paper exam OT		Computer exam OT		Paper exam essay		Days from last formative OT to	
	Average (%)	Fail (%)	Average (%)	Fail (%)	Average (%)	Fail (%)	OT	Paper exam
1, 1990–1991	47	31			55	7	n/a	n/a
2, 1991–1992	60	10			52	6	27	27
3, 1992–1993			71	None	58	7	12	20
4, 1993–1994			64	11	52	20	7	23
5, 1994–1995			56	25	38	36	6	46

*Only 15% of the students did the essay question in the 1994–1995 examination; in the previous 4 years, the essay was compulsory.

failed to notice their results had not been saved and exited the programme before another attempt could be made to recover the data. In the fifth test and in the following years, no further data storage problems occurred.

Table 5 summarizes the main problems encountered using OTs during the 5 years 1990–1991 through 1994–1995.

Other data collected

School-leaving qualifications data was held for all students for all years, as was their performance on the first year course, *Professional Accountancy Practice* – the introductory level course on double entry and financial statement preparation (L1). In addition, the 1992–1993 and 1993–1994 cohorts were invited to complete the Honey and Mumford (1992) *Learning Style Questionnaire* (see Wilson and Hill (1994) for a review of *learning styles*) Table 6 presents this data in summary form ('*H*' points are the number of points gained at SCE higher grade on the basis of $A = 3$, $B = 2$ and $C = 1$.)

Data review

Consideration of Table 3 reveals some marked similarity across the years in performance on the formative OTs. The second OT had an average mark over 4 years within the range of 71–74% and failure rates on that test ranged from 0 to 3%. If only the last 3 years are considered (they had no requirement for an overall average on the tests, whereas the 1991–1992 course had a 50% overall average requirement), the average marks are virtually identical in the second, third and fifth tests.

Given the change in the sequence of activity in the 1994–1995 tutorials, compared to the previous approach of sitting each test immediately before the tutorial, this similarity between the last 3 years was unexpected. Intuitively, it was anticipated that this would lead to a higher level of performance on the tests. Possibly the students were too nervous about the approaching test for them to succeed in absorbing and applying what was said in the tutorial when they took a test. It does suggest that there may be no advantage in holding a tutorial immediately before a test. Indeed, adopting this approach removed the opportunity for

Table 5 Problems encountered with use of OT-based assessment 1990–1991 to 1994–1995

Year	Tests saved to	Problems
1, 1990–1991	Paper	Resistance from colleagues
2, 1991–1992	Floppy discs	None, though the discs were inconvenient
3, 1992–1993	Server	Loss of data due to server problems and save failures
4, 1993–1994	Server	None
5, 1994–1995	Server	None

immediate remedial discussion on items that had caused students problems in a test – a loss of an opportunity to deepen the learning process that may have contributed to the difference between the performance in the summative OT in 1994–1995 (56% average and 25% failure rate) compared to 1993–1994 (64% average and 11% failure rate).

There are some notable exceptions to the general similarity in the formative test results across the years, the greatest being the comparison between the fifth test result for 1991–1992 and the result on the same test in the three later years – an average of 61% and a 1% failure rate, compared with an average of between 38 and 40% and a failure rate between 42 and 60%. The need to attain a 50% average in 1991–1992 was clearly a strong motivator on that test. All the students knew what they needed to achieve to attain a 50% average: 44% needed to achieve more than 40%, 24% required more than 50% and 13% needed more than 60%. Dropping the requirement for an overall average appears to have led to a reduction in effort on the final test. Strategically scheduling the ‘most important’ topic in a course for the final formative assessment, while adopting a non-trivial overall average requirement, may be a

Table 6 Summary data on the 1992–1993 and 1993–1994 students who completed the *Learning Style Questionnaire*

	H-points	L1	Sum- mative OT	Exam- ination	Activist	Reflector	Theorist	Pragmatist	Overall
1992–1993									
Mean	11.76	16.41	70.02	59.46	7.40	12.88	8.98	9.44	38.70
SD	3.13	2.41	15.09	10.91	4.26	3.92	3.56	4.31	10.90
Minimum	3	11	42	24	0	4	3	2	17
Maximum	18	20	96	79	19	20	18	18	61
Count	38	41	50	50	50	50	50	50	50
1993–1994									
Mean	12.69	14.74	65.01	53.19	6.30	10.60	7.28	7.21	31.40
SD	3.47	3.88	17.98	14.14	3.35	4.86	3.81	3.95	11.69
Minimum	6	7	22	20	0	0	0	0	9
Maximum	20	20	98	75	13	19	14	15	51
Count	26	38	43	43	43	43	43	43	43

very effective way of achieving a high level of knowledge and understanding of that topic. However, allocating a topic at random to the final formative test could be highly counter-productive as the students may become 'experts' on a relatively trivial element of their course, at the expense of their studying other material.

In their experiment involving students on a tax course, Murphy and Stanga (1994) found no evidence to support the hypothesis that frequent formative assessment enhances summative examination performance. A comparison of the 1990–1991 summative OT marks with those for 1991–1992 suggests the opposite view. (In 1990–1991, there was only one mid-session formative assessment; in 1991–1992 there were five formative assessments.) However, the OT was not the same in these 2 years and no reliable test of the difference is possible. Nevertheless, it does suggest that this is something that may be worthwhile investigating in future research. The Murphy and Stanga (1994) study compared two groups, one of which had OT questions spread over six tests, while the other group answered the same questions, but over three tests. In the case of this study, the one formative test the 1990–1991 group sat was shorter than any of those sat by the 1991–1992 group – that is, there was a far greater contrast between the two groups than existed in the Murphy and Stanga (1994) study.

Another possible factor observable in the data concerns the essay performance in the final examination. Sangster and Wilson (1991) suggested that students who perform better than others on formative assessment may lose the impetus of that knowledge lead when their colleagues have had some time subsequently in which to study the topics prior to a summative assessment. An alternative hypothesis could be that without reinforcement students suffer loss in the extent of their knowledge and understanding over time, and that those who had performed well on the formative assessments would not be so inclined, all other things remaining equal, to invest large amounts of time revising topics they had already found themselves to know well.

Taking the last 3 years when the summative OT was identical, the greater the period between the summative OT and the written examination, the worse the students did in the written examination. A loss of the level of knowledge and understanding possessed at the time of the summative OT may have occurred. Alternatively, the examination may not have been at the same level of difficulty, the assessor may have adopted different marking criteria or the students may have been of a different standard.

Statistical analysis of the data is required if any more specific conclusions are to be reached concerning the students' performance.

Statistical analysis

The statistical analysis was restricted to 1992–1993 and 1993–1994 (years 3 and 4), those being the 2 years when an identical approach was adopted, and also the years for which *Learning Style* data was available (i.e. data on the students' approach to learning that had been obtained through their completion of the Honey and Mumford *Learning Styles Questionnaire*). Comparing the two groups, there was no significant difference between their performance on the summative OT (*t*-test, 0.05 level of confidence), suggesting that the two cohorts were generally of similar ability. However, there was a significant difference between the essay scores of the two groups, suggesting a possible difference in difficulty or a difference in marking between the 2 years.

Another possible explanation can be derived from the proposal made by Bouwman and

Knox-Quinn (1995) that differences between assessments may be due to students being examined on different elements of their learning. That is, the score achieved in one assessment may have little relationship with the score achieved on another assessment, even though the same domain knowledge is being assessed, if a different form of competence or a different level of Bloom's taxonomy is being assessed in each case. In the context of this paper, the objective tests required that the students had good surface knowledge of the material, but they were only required to apply that knowledge within the context of the standard being assessed. In the written examination, they were required to demonstrate a deeper-level knowledge of a range of standards simultaneously. Applying the hypothesis of Bouwman and Knox-Quinn (1995) to the current study, there would be no reason to presume that because the OT marks of the two groups were not significantly different, the same would hold for the essay marks. Rather, the OT and the exam would not be likely to produce similar results student-by-student.

Support for the Bouwman and Knox-Quinn (1995) theory was given when no significant correlation was found in either year between the summative OT score and the exam essay score (Spearman sign rank test, 0.05 confidence level), suggesting that these two assessment methods were identifying different factors in the students. Clearly, this finding has repercussions for the use of these two forms of summative assessment. If similar results were found elsewhere, this has significant implications for professional examinations where there is a marked move towards objective testing, particularly in the USA, but also in the UK and elsewhere. It also has implications in higher education, for it would suggest that the effect of introducing a mixture of objective testing and essays, where previously there had only been essays may result in the overall spread of marks narrowing (as a 'good' student on one criterion, has a 'good' mark offset by a 'poorer' mark on the other criterion) compared with how they would appear were either assessment method being used on its own. Substituting marks with ranks and calculating performance on that basis would make little difference, for a different rank order of students will apply under each assessment method.

This result is consistent with the view in the literature that students will adopt a surface approach for OTs, but a deeper approach for essay-based assessment. Some students will be more suited to OTs and they will tend to out-perform their peers under that approach. However, when the other form of assessment applies, other students will be better suited to it and they will out-perform their previously 'superior' colleagues.

Table 7 presents a summary of the other statistical results relating to each of the 2 year groups.

From a *Learning Style* perspective, no correlation was found between either group's essay scores and their *learning styles*. However, for the 1992–1993 students, the *activist* dimension was found to be significantly, but negatively correlated with the summative OT score (Pearson correlation, 0.05 confidence level). That is, the higher the *activist* score, the lower the mark achieved on the summative OT – as *activists* tend towards impulsiveness, this would be consistent with an intuitive view that anyone rushing an OT is likely to make errors because questions were not read carefully enough.

The *reflector* dimension was found to be positively correlated with the OT scores of the same group – as *reflectors* tend to think carefully before acting, this appears consistent with an intuitive view that anyone who considers OT questions carefully before answering is less likely to make errors as a result of misinterpreting questions.

A very different picture emerged for the 1993–1994 students, for whom no significant correlations were found between their OT scores and their *learning styles*.

Table 7 Statistical test results within year groups (✓ = significant at 0.05)

	OT	Essay	H-Points
1992-1993			
Essay			
H-Points	✓		
L1	✓		
Activist	-ve ✓		
Pragmatist			
Reflector	✓		
Theorist			
1993-1994			
Essay			
H-Points			
L1		✓	
Activist			
Pragmatist			
Reflector			
Theorist			

Comparing the *learning styles* of the two student groups (shown in Table 6), the 1992-1993 group scored higher on all four dimensions. In all but the *activist* dimension, this difference was significant (Anova, one-way analysis of variance, 0.05 confidence level), suggesting the 1992-1993 group had a more dynamic *learning style* than the 1993-1994 group - they would be more likely to act in a pragmatic fashion, and more likely to think carefully before acting. The significant relationships found for the 1992-1993 students may have been noticeable because of their generally higher level of *learning styles*, the 1993-1994 students' *learning styles* being insufficiently pronounced to make any noticeable impact on their general approach to answering OTs.

This analysis is consistent with the corollary of Honey and Mumford's (1992) view that the higher the score achieved on any particular style, the more an individual would exhibit traits associated with that style.

Two other data items were available - the students' school-leaving grades and their performance on the equivalent first level financial accounting course (L1). Pearson correlation tests (at the 0.05 confidence level) between the students' SCE higher grade points and their summative OT scores found a significant positive relationship for the 1992-1993 students, but none for the 1993-1994 group. No significant relationship was found for either group between their SCE higher grade points and their essay marks. Intuitively, the higher grade points would be expected to be more likely to correlate to the OT marks, as they would tend to be awarded on the basis of knowledge of facts rather than a deep understanding of those facts - i.e. a surface approach would be a sensible strategy to adopt, particularly when students may be studying as many as six or seven higher in the same year.

As with the higher grade points, intuitively, a correlation would be anticipated between the L1 scores and the OT. The L1 examination was 50% OT and 50% computation/presentation, suggesting that an appropriate strategy for students would be surface-based. Similar tests between the students' marks on the L1 course and their summative OT marks found a significant positive correlation for the 1992-1993 students, but none for the 1993-1994

group. However, the reverse was found between the L1 marks and the essay marks – no significant relationship for the 1992–1993 students, but a significant positive relationship existed for the 1993–1994 students.

Comparing the 2 year groups, there was no significant difference identified between their SCE higher grade points (*t*-test, 0.05 level of confidence). However, there was a significant difference between the L1 scores of the two groups, with the 1992–1993 group achieving significantly higher marks than the 1993–1994 group. No significant relationship was found for either group between their SCE higher grade points and their L1 scores.

The contrast between the 1992–1993 students and the 1993–1994 students was very unexpected. The students in the two groups had similar backgrounds and similar prior entry records, yet their *learning styles* were very different. An explanation for the significant correlation between the 1993–1994 students' L1 marks and their essay marks can be proposed from the data: the fact that the 1993–1994 students scored significantly worse on the essays (than the 1992–1993 students) and that their performance was correlated significantly with their L1 scores could have occurred because they were insufficiently motivated to alter their learning strategy for the essay and approached it with a similar surface-based approach to that which they adopted for the L1 examination and the OT. The 1992–1993 students, with their more dynamic *learning styles* altered their learning strategy for the essay, hence the lack of any correlation between their essay scores and any of the (more *surface learning* approach-suited) higher grade points, L1 marks, or OT marks. While it is not possible to test this hypothesis using the data available, it does seem a plausible explanation for an otherwise confounding result.

If it is the case that the 1993–1994 students' low levels of *learning styles* contributed to a failure to adjust their learning strategy, this could help to explain the conflicting results from various published studies on the effects of prior learning on academic performance – see, for example, Baldwin and Howe (1982) and Bergin (1983) (both studies found initially superior performance, that diminished and had disappeared by the end of the first year), Mitchell (1985, 1988) (who found initially superior performance, but on computation only), Schroeder (1986) (who found superior performance, but it disappeared after the first examination unless more than 1 year's prior study had been done, in which case performance was always superior) and Farley and Ramsay (1988) and Peel *et al.* (1991) (who found superior performance). Others suggest there is no benefit (Keef, 1992; Sangster and McCombie, 1993). One study of particular relevance is Bartlett *et al.* (1993), who conducted a longitudinal study on student performance over a 3 year degree programme. They included virtually all the commonly used explanatory variables (of student performance) and concluded that the 'determinants of student performance ... cannot be found in the background characteristics ... tested in this study ... it may be that there are other characteristics not identified in this study that affected performance ...' (pp. 119–20). They did not include *learning styles* in their study. The findings of the current study suggest that *learning style* is a variable that *needs* to be controlled for in any explanatory study of student performance.

Other research lends support to that view. Gul *et al.* (1992), found that field-independent students performed better on OTs with ambiguous alternatives. Geiger (1992) found that performance was related to *learning style*, students with *learning styles* closest to the instructor doing best. McKee *et al.* (1992) found differences between the *learning styles* of American and Norwegian students and concluded that educational programmes should be designed to match the *learning styles* of the students. Waldemann *et al.* (1993) found that attitudes towards the form of assessment differed between South East Asian and Australian

students. They conclude that 'further research is needed into the ways in which examination methods for accounting subjects are conducted and the appropriate combination of assessment methods suitable for students from different cultural backgrounds ... many factors affect student performance and simplistic untested explanations of achievement are inadequate' (p. 207).

Conclusions

This paper has described the evolving process of change in the approach to assessment that was followed over a 5 year period in a course on the regulatory framework. The students' performance over this period has been reviewed and a detailed comparison made between the performance of 2 year groups during the most stable part of the process of change. Background variables were introduced in order to clarify the data. While the results are from one study and cannot be blindly generalized beyond the context of that study, a number of conclusions can be drawn from the analysis which have implications that should be considered by any tutor considering introducing, or who is already using OTs.

1. Compared with traditional examination essays, the study found that OTs appear to focus on different aspects of students' knowledge, understanding, and ability to apply that knowledge and understanding.
 - (i) This will produce a different ranking among students and, where the two methods are combined, is likely to result in a narrowing of the range in the overall marks compared to that found separately under either method.
 - (ii) Tutors who adopt OTs ought to consider the implications of using them, particularly the possibility that performance may be significantly linked to individual *learning style*, rather than solely to the intrinsic academic ability of the student.
 - (iii) It may be appropriate to consider tutoring students on how to adjust their *learning style* to cope more effectively with OTs, particularly those students with *high activist learning styles*.
2. Regular formative OTs which require a minimum average mark in excess of the pass mark were found to produce a different pattern of performance compared with those where students were required simply to pass each test.
 - (i) If an overall minimum average approach is adopted, students will be likely to perform better, particularly in the final test when they know they have to achieve a minimum mark, possibly significantly in excess of the mark required to pass the test.
 - (ii) This will have repercussions for the scheduling of material – the final test should be on material that is considered 'important', as opposed to being on fairly unimportant material, for example, when a test is constructed because it is required, rather than to assess anything specific.
3. It appeared that there was no benefit to students in holding tutorials on a topic immediately before an OT on that topic; and it may be that doing so resulted in a loss of an opportunity to develop deeper understanding had the tutorial taken place immediately after an OT.
4. School and first-level university examinations that assessed surface learning were found to be good predictors of performance on the second-level summative OT when

individual student *learning styles* were evident; however, where the *learning styles* were low, no predictive ability was found in these background variables.

- (i) It appeared as if low individual *learning style* scores could lead to inappropriate learning strategies being adopted – in effect, students with low levels of *learning styles* appeared to have been unable to adjust their approach to learning when the form of assessment altered from one requiring surface learning to one that required deep learning.
- (ii) If accounting educators are to teach students to ‘learn how to learn’, it may be appropriate to assess each student’s *learning style* and counsel those with low level *learning styles* in ways to raise those levels to a point where they will respond to changes in the method of assessment.

Overall, this study has revealed a number of issues that merit further research. The issue of whether frequent formative tests enhance summative performance does not appear as clear as the literature may suggest. However, the major issue raised by this study is the role of *learning styles* in predicting and/or explaining student performance. More work is urgently required on assessing whether there is a point at which the level of an individual’s *learning styles* is so low as to result in students adopting inappropriate learning strategies. If there is such a level, and this study suggests there may be, this will have significant repercussions for the achievement of the major aim of accounting educators to teach students to ‘learn how to learn’.

References

- Baldwin, B.A. and Howe, K.R. (1982) Secondary-level study of accounting and subsequent performance in the first level college course. *The Accounting Review* 57 (3), 619–26.
- Bartlett, S., Peel, M.J. and Pendlebury, M. (1993) From fresher to finalist: a three year analysis of student performance on an accounting degree programme. *Accounting Education* 2 (2), 111–22.
- Bergin, J.L. (1983) The effect of previous accounting study on student performance in the first college-level accounting course. *Issues in Accounting Education* Fall, 19–28.
- Bouwman, M.J. and Knox-Quinn, C. (1995) Student knowledge engineering in accounting: a case study in learning. *Accounting Education* 4 (3), 231–48.
- Brown, G. and Pendlebury, M. (1992) *Assessing Active Learning – Part 1*. Sheffield: CVCP.
- Bull, J. (1993a) Introduction to the papers. In *The Workshop Papers from the Teaching and Learning Technology Programme Workshop on Assessment of Learning in Higher Education, Sheffield, 1993* (edited by J. Bull). Sheffield: CVCP.
- Bull, J. (1993b) *Using Technology to Assess Student Learning*. Sheffield: CVCP.
- CNAA (1989) *How Shall we Assess Them? Information Services London Discussion Paper 1*. London: Council for National Academic Awards.
- Entwistle, N., Thompson, S. and Tait, H. (1992) *Guidelines for Promoting Effective Learning in Higher Education*. Edinburgh: Centre for Research on Learning and Instruction.
- Farley, A.A. and Ramsay A.L. (1988) Student performance in first year tertiary accounting courses and its relationship to secondary accounting education. *Accounting and Finance* 28 (1), 29–44.
- Geiger, M. (1992) Learning styles of introductory accounting students: an extension to course performance and satisfaction. *Accounting Educator’s Journal* 4 (1) 22–39.
- Gul, F.A., Teoh, H.Y. and Shannon, R. (1992) Cognitive style as a factor in accounting students’ performance on multiple choice examination. *Accounting Education* 1 (4), 311–19.
- Honey, P. and Mumford, A. (1992) *The Manual of Learning Styles*. Maidenhead: Peter Honey.
- Hoskin, K. and Steele, A. (1991) *Assessing the Business Professional*. London: ICAEW.

- Keef, S.P. (1992) The effect of prior accounting education: some evidence from New Zealand. *Accounting Education* 1 (1), 63–8.
- Laurillard, D. (1993) *Rethinking University Teaching* (p. i). London: Routledge.
- McKee, T.E., Mock, T.J. and Flemming Ruud, T. (1992) A comparison of Norwegian and United States accounting students' learning style preferences. *Accounting Education* 1 (4), 321–41.
- Mitchell, F. (1985) School accounting qualifications and student performance in first level university accounting examinations. *Accounting and Business Research* 15 (58), 81–6.
- Mitchell, F. (1988) High school accounting and student performance in the first level university accounting course: a UK study. *Journal of Accounting Education* 6 (2), 279–91.
- Murphy, D.P. and Stanga, K.G. (1994) The effects of frequent testing in an income tax course: an experiment. *Journal of Accounting Education* 12 (1), 27–41.
- Peel, M.J., Pendlebury, M.W. and Groves, R.E.V. (1991) The determinants of students' financial awareness—some UK evidence. *The British Accounting Review* 23 (1), 23–48.
- Sangster, A. (1991) *Workbook of Accounting Standards*. London: Pitman.
- Sangster, A. (1992) Computer-based instruction in accounting education. *Accounting Education* 1(1), 13–32.
- Sangster, A. and McCombie, I. (1993) How well do accountancy students understand a set of accounts? *Accounting Education* 2, 53–70.
- Sangster, A. and Wilson, R.A. (1991) Knowledge-based learning within the accounting curriculum. *British Accounting Review* 23, 243–61.
- Schroeder, N.W. (1986) Previous accounting education and college-level accounting examination performance. *Issues in Accounting Education* 1 (1), 37–47.
- Waldemann, E., Romano, C.A. and Smyrniotis, K.X. (1993) Attitudes towards objective testing: a cross-cultural perspective. *Accounting Education* 2 (3), 201–9.
- Wilson, R.M.S. and Hill, A.P. (1994) Learning style – a literature guide. *Accounting Education* 3 (4), 349–58.

6. Sangster, A. (1995), *World Wide Web - what can it do for education?*, *Active Learning*, Vol. 1, No. 2, July, pp. 3-8.

World Wide Web - what can it do for education?

Alan Sangster, University of Aberdeen

(<http://www.abdn.ac.uk/~acc025/alans.html>)

World Wide Web has been growing at a phenomenal rate. It contains a vast array of information ranging from news, to government information, to entertainment, to the ability to purchase pizzas and visit Santa Claus. The next generation of entrants to higher education are going to be both well aware of its existence and IT confident, that is, well beyond basic IT literacy. They are going to demand access to it will be highly motivated to explore and discover the breadth of information it contains. As educators, we can either allow students complete undirected access, or we can learn what is available on it and adjust our approach to education in the light of the possibilities that it offers.

This paper reviews what the Web currently offers to educators, using accounting education as an example, and considers ways in which it may impact upon our current approaches to teaching and learning.

Further information

Further information is available from:

Alan Sangster
Department of Accountancy
University of Aberdeen
Aberdeen AB9 2TY
United Kingdom

Tel: +44 (0) 1224 273395

Fax: +44 (0) 1224 272214

Internet: a.sangster@abdn.ac.uk

Introduction

Similarly with educators in other domains, accounting educators, are charged with the objective of teaching our students to *learn how to learn* and to educate them to *understand the current and future roles of information technology in organisations*^{1,2}. In their 1994 Discussion Paper, *2000 and Beyond*, The International Federation of Accountants³ state that:

"In any consideration of the education and training of future professional accountants, consideration must be given to the implications for the profession of the accelerating developments in the area of information technology. ..Such developments prescribe a new approach to professional accounting education and training. This will require that the latest tools and techniques of high technology be integrated into the professional pre-qualification education, training and life time learning of the future accountants."

World Wide Web represents a new concept in technology, the library on your desktop, the dictionary at your finger tips, the sound at your ear. There is nothing that we hear or see that will not be accessible through WWW. Laser discs and CD-ROMs can both provide similar information in reasonably large quantities, yet the Web has the added advantage of being free (virtually) and not restricted to the amount that can be squeezed onto one CD, or even a lorry load of CDs. With virtually 5 million *host* computers linked to the Internet⁴, and estimates of many times that number of actual users, there are a huge number of potential Web page authors, each of whom will be adding some new information to the vast reservoir that already exists.

The various ways in which the Web can currently be accessed are documented elsewhere (see, for example, Lymer⁵). The choice is vast, and about to become greater still as major software companies join the group of Web browser providers. Microsoft is currently (March 1995) beta testing The Internet Assistant a Web browser add-in for Microsoft Word 6 (<http://www.microsoft.com/pages/deskapps/word/ia/default.htm>). Novell (WordPerfect) and the other major players in this market are not far behind.

Figure 1 reveals that the Internet Assistant has distinct similarities to a wordprocessor. This is no coincidence, it is a style sheet template within Word. This will be typical of this new generation of browsers: they will enable anyone using a wordprocessor to create Web pages without any need to know how to write in HTML (the programming language used to write those Web pages). The effect is likely to be an explosion in Web pages, intuitively these will likely (initially) be of lower quality than the current norm (as anyone wanting to do so now has to devote a few hours to learning the basics, and a bit of the culture and mores of HTML writing will tend to be acquired as most self-tutors incorporate advice on these matters). The overall effect will be an even greater reservoir than at present of information that must be sifted through if something useful is to be found. The problems for accounting educators are knowing how to find appropriate information, knowing how to use it, and knowing what to tell the students. The rest of this paper addresses each of these issues.

How to find information on World Wide Web

There are three basic approaches:

- 1 via multi-dimensioned lists;
- 2 via flat lists;
- 3 via search engines.

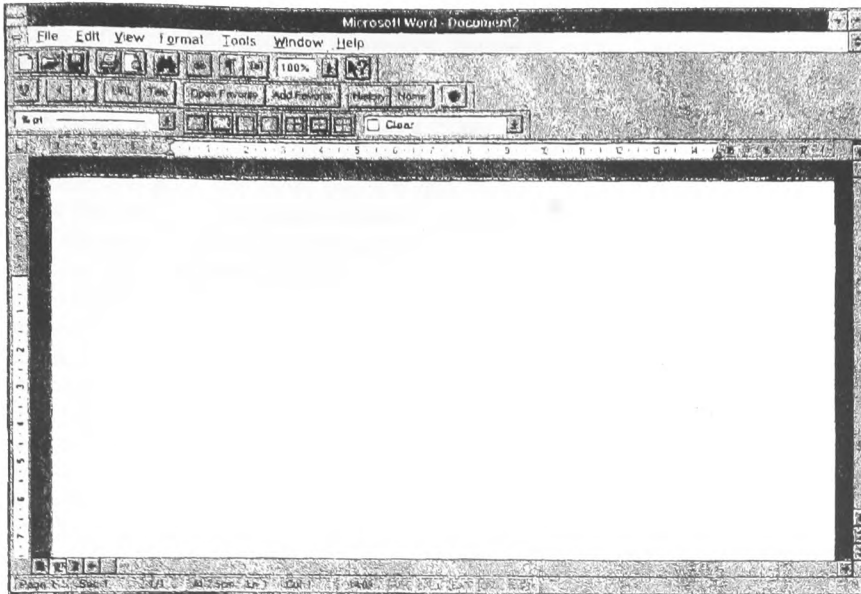


Figure 1: Microsoft's Internet Assistant

1 Multi-dimensioned lists

Currently (22 March 1995), Yahoo has 34,358 entries in its menu structure (<http://www.yahoo.com>). It is probably the most comprehensive and easy-to-use multi-dimensioned route to interesting material; and has only recently migrated from Stanford University (where it was created by two students) to a site under the auspices of Netscape, one of the main browser providers. However, even Yahoo can only scratch the surface of what is available.

2 Flat lists

Other forms of structured alternatives are general personal lists such as Scott's Internet Hot List (<http://wvnm.wvnet.edu/NETBOOK.HTML>) and Scott Yanoff's Special Internet Connections (<http://mendel.berkeley.edu/inet.services.html>). These are not small lists, as Figure 3 shows. All the items listed in Figure 3 are links to other pages which the compiler of the list believes to be related to commerce. The Commerce sublist given here is just a small part of Scott's Internet Hot List. The main difference between a list of this type and the Yahoo list is its flat structure (the entire list is accessed at once, which means a delay in loading a file of around 121,000 bytes, but very fast movement through the list once loaded).

Personal lists tend to be much more specialised than these examples of general personal lists. Nevertheless, they can be extremely comprehensive within their author's range of interest, and often as large as even the large general personal lists. Examples are many and varied, but one of the largest UK subject specific lists is Stephanie Warwick, of University College, London's list of AI, Cognitive Science and Robotics WWW Resources (<http://www.cs.ucl.ac.uk:80/misc/ai/>) - another flat list, this time of 91,000 bytes.

One great advantage the flat list has for everyone other than the original author is that they can be easily copied and stored locally. While multi-dimensional lists, such as Yahoo, are quicker to access, every layer within them is accessed separately. Copying Yahoo's pages locally would be a very tedious task compared to an equivalent flat list. In the case of both forms of list, because the HTML code is freely available, they can be

used as the basis for a new list without the *new* author having to painfully re-enter every item from the old list. As an example of the work entailed if something is re-entered, Figure 4 shows the first four lines of Scott Yanoff's Commerce sublist in HTML code.

3 Search engines

The multi-dimensioned and flat lists are excellent ways to find some information on most topics. Yahoo has probably something on anything anyone would be interested in. However, these lists are not intelligent, that is, they do not know when something new has been added, they have to be told. This creates two bottlenecks. Firstly, someone has to be motivated to inform the people maintaining these lists about a new resource (or a change in URL, ie address of an existing one). It can typically take up to one week for the list organisers to act upon information concerning a new link, and when they do they are faced with the problem of deciding precisely where to place the link. Often, they will rely on the judgement of the informant. However, this has the unfortunate effect that multiple links to the same resource are not uncommon, and links at different levels in the multi-dimensional lists to the same form of resource (eg conference and journal information) can result in casual browsers who find information assuming there is no more, when in fact there is another relevant link a few levels removed from their current position.

For anyone who wishes to *really* discover what is available on the Web on a given topic, there is little option but to use a *search engine*. Details of many can be found elsewhere (for example, Lymer⁵) and users of the Netscape browser have a ready made menu of the major search engines if they click on the *Net Search* button at the top of the screen. Other Web browsers can access this information at URL: <http://home.mcom.com/home/internet-search.html>. This particular page provides a summary of the characteristics of some of the best known search engines, including a comparative performance of a given search, and details (where known) of the number of pages in their database. The home page to the Lycos search engine is shown in Figure 5 (<http://lycos.cs.smu.edu>).

In common with all the search engines, a Lycos search is performed by entering keywords. Figure 6, shows the page where this takes place: note the statistical information at the top of the page, almost 2.25 million pages were known to Lycos as of 17 March 1995. These two examples of the Lycos interface are typical of all the search engine interfaces: they are easy to use, even for the absolute beginner. However, comparing each of the search engines, the breadth of search capability and the sophistication of the search query is distinctly different. Some allow only very simple searches, others can undertake searches on very complex word structures. They are also growing at vastly different rates. Intelligent robots gather the information comprising their databases and the extent of discovery is governed by how they are programmed to search: Lycos claims to add 5,000 new items to its database daily, and does appear to do so. As a result, the amount of information contained in their databases is not only vastly greater than is held by any of the Web lists, the relative difference is growing at a geometric rate.

Wide range searching

The choice of information discovery approach made by any Web user has to be a compromise. The multi-dimensional list is easy to use, but can be subject to delays while layers are passed through, and information may be missed due to ambiguous locations having been used. Personal *general* flat lists may take a significant time to load, and are not as comprehensive as the best multi-dimensional lists. However, personal *specialised* lists will often be more comprehensive than any of the multi-dimensional lists. Generally, the casual user, and most students would be wise to restrict most of their searches to these sources. There is enough information

on most subjects to satisfy their interests with minimal wasted time and effort. The serious searcher, however, is faced with the indisputable fact that something significant may be missed unless the search engines are used. A sensible strategy would be to use the lists initially, gathering the obviously relevant material together. Once that was *completed*, the search engines could be used to discover whether anything else was available.

A search can take a long time. There may be difficulty accessing some of the more popular search engines, never mind delays while the search is under way. A search of Lycos for the word *accounting* took over two hours, found 2,173 pages with references to the word, and the list it generated was over 2 megabytes long. (Most of the time that elapsed was spent creating a page with links to all the pages identified in the search, the original search took under two minutes.) That search was set to find a maximum of 99,999 occurrences. Had it been set to the default of 15, it would have been completed virtually instantly, but the serious researcher cannot afford the luxury of 15 item searches (what was found last time will be found again the next time). Consequently, the greatest search feasible should be undertaken. Unfortunately, that means there may be a fairly large number of possible pages identified, and the only way to discover whether a page may be of interest is to visit it. Even allowing a conservative 30 seconds to link to and check out a page, a list of 1,000 links would take over 8 hours to vet.

Clearly, searches can be narrowed down, but narrowing down a search may be taken too far, resulting in missing possible sources of information. Also, due to limitations in syntax flexibility, some of the search engines may be incapable of narrowing down a given search in the most appropriate way.

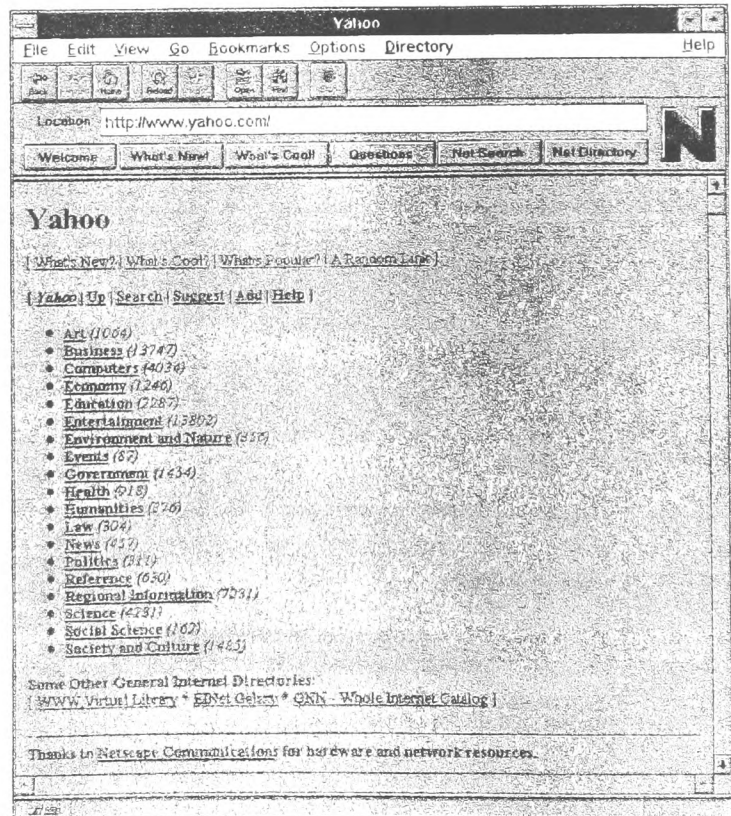


Figure 2: Yahoo

18th Congress of European Accounting Association
 Asia Travel Market 1995
 Atlanta Business Information Exchange
 Auditor General of Canada's 1994 Annual Report
 Canadian Business Information
 Chicago Mercantile Exchange
 CommerceNet
 Commercial Services on the Net
 Company Corporation
 Dow Jones Industrial Average
 Dun & Bradstreet Information Services
 Economics
 EXPO Ticket Office
 Ernst & Young, United Kingdom
 Finance Web, University of Texas
 Fredericton, Canada Industry Directory
 G7 Economic Summit, June 1995, Nova Scotia
 GNN PFC: Money Watch
 IndustryNET
 Interactive Nest Egg
 Internet Business Center
 Internet Business Directory
 Internet Jungle Ontario, Canada business
 Japan Guide for the Companies JICST
 Japan Information Center of Science and Technology JICST
 J.P. Morgan, Risk Metrics
 Markets and Investments
 Market Link
 Million Dollar Bill
 Nashville Business Journal
 NetManage
 NETnavs Request
 NETworth by GALT Technologies
 NYU EDGAR
 NYU EDGAR CIK and Ticker Lookup
 NYU Search SEC EDGAR Archives
 NYU Stern School Information Systems Department
 PAWWS
 Personal Finance Center
 Personal Investment and Tax Information
 Product Development Centre, Canada Communication Group
 R.R. Donnelley Financial
 Security APL Quotes
 Security Exchange Commission SEC EDGAR
 Small Business Administration SBA
 South African trade, business & industry promotion
 Stock Doctor
 Stock Market Charts
 Stock Market Information
 U.S. Council for International Business
 U.S. Department of the Treasury
 United States Industry Coalition (USIC)
 WealthWEB
 World Bank

Figure 3: The COMMERCE sublist from Scott's Internet Hot List

Someone wishing to undertake the fullest possible search of the Web would need to use virtually all the *search engines* and then filter all their results: a potentially enormous task. However, the serious researcher who wanted to dip into the resources on the Web could still find a vast amount of information with a much smaller search than the search for *accounting* on *Lycos*.

Application to education

World Wide Web is available in all higher education institutions with a connection to the Internet. The current standard is for student labs to be equipped with

Netscape or Mosaic, generally the PC version. However, connections from sites in the UK to the rest of the world can be very slow, and are occasionally subject to being down at weekends, or overnight, due to a fault in the mainland cable, or in the transatlantic connection. For now, both academic staff and students require to be very patient and to be generally computer confident (ie well beyond a basic level of computer literacy, to the extent that no matter what happens, no panic occurs) if they are to make effective use of World Wide Web.

Yet, in the relatively near future, certainly within the next five years, these connections are going to improve dramatically, and with the combination of ever increasingly powerful PCs, Internet ready wordprocessors, and rapid links to resources, student interest and demand for use is liable to be very high. There are a great deal of entertainment-related resources on World Wide Web and these will attract members of the *Sega* generation. Students are likely to use World Wide Web as they would use a television, some will almost certainly use the same piece of equipment for both sources of entertainment.

Educators can either ignore the resources in World Wide Web, hoping that students discover for themselves information relevant to their studies, in a manner similar to how many currently expect students will use the library; or they can use the Web to help achieve the aim of teaching students to *learn how to learn*. Of these strategies, the first could prove disastrous for the educator, the second can only succeed. Learning how to learn is all about being able to adapt, to being able to take past experiences and use them in the future, both in and out of the original context, to being able to take a skill and alter or adjust it to work in a different context, and to being able to learn new things when required.

Setting students a task involving their searching World Wide Web for information will develop their skills of deduction, their skills of lateral thinking, their adaptability, and many other attributes that will be useful to them in later life. It will also teach them a great deal about what other people think about a subject, what they find interesting, what is contentious, and what is generally agreed. They will find working papers, published articles, extracts from books, photographs, pictures, film, even sound of relevance to their search. They can discover lecture notes and course materials from institutions scattered across the world and get a totally different perspective on their studies from that being presented by their tutor. Effectively motivated, students can be taught how to seek out information whenever they require it, without ever needing to leave their room in the Halls of Residence, or the most convenient computer.

The educator who does not encourage students to use World Wide Web in this way and who him or herself does not look at it to see what is available there, resembles the stereotype professor who has never considered changing the course textbook since he started teaching the subject and whose reading list resembles the remainder list in a second-hand bookshop. Students may not be aware of any defects in the book or in the booklist, but they will notice when the course notes in other institutions indicate that there are different ways of doing things and/or that some of the material being presented may not be terribly up-to-date or relevant. In addition, students will approach their tutors and ask why mate-

```

<DT><A HREF="http://www.bham.ac.uk/business/
eaacong.html">18th Congress of European
Accounting Association</A>

<DT><A HREF="http://silkroute.com/silkroute/reed/
exhibition/atravel/index.html">Asia Travel Market
1995</A>

<DT><A HREF="http://www.ble.net">Atlanta Business
Information Exchange</A>

<DT><A HREF="gopher://gopher.phoenix.ca:70/11/
.auditor/">Auditor General of Canada's 1994 Annual
Report</A>

```

Figure 4: HTML code of the first four lines shown in Figure 3

rial elsewhere is different, why it contradicts what they are being told; and they will ask what their tutor's opinion is of some of the material *and will expect* their tutor to know what they are referring to. And that is just the teaching resources on World Wide Web. Students who do major searches on World Wide Web could quite easily be well ahead of their tutors on the latest research developments, may even be in contact with some of the leading researchers and using their feedback in tutorials with their tutor.

These scenarios are not imaginary. They can occur even now, even with the poor quality of hardware interface and imperfect software that is generally in use. During the last semester, the author was questioned on the course notes of another tutor based 6,000 miles away, and found evidence in coursework of students having traced material through World Wide Web.

A strategy to adopt

World Wide Web has the potential to alter permanently the way in which academics teach and students learn. Unlike the spreadsheet which has been slowly adopted by academics for their own use, but remains less than in general use across the range of courses where it could usefully be integrated, the Web will be used by students for entertainment. They will be well aware of how to use it, and of how to find items of interest on it. It could be argued that we need do nothing to enhance their ability to find relevant information, but we would be failing to involve them in applying the information they had obtained, in learning how to manipulate information and use it for a specific purpose.

World Wide Web represents an enormous resource that can be utilised to enrich the lives of academics and students. Presently, the level of usage is still in its infancy and now is the time for experimentation and discovery, but this will not last long: 42% of the author's first level managerial accounting class of 140 students were using the Web by the end of the course, despite none of them knowing how to access it at the start. Among the comments in the course feedback forms was a request that in future students be given formal instruction at the start of the course in how to access the Web (as opposed to a mid-course handout).

An appropriate strategy at this time may be to get acquainted with the resources, learn a bit about searching for information, and then decide for oneself how to use the resource. The only effective way to assess the true potential of World Wide Web is to experience it. However, that need not be a difficult or unpleasant experience. Existing lists can be used very easily to guide the exploration. Once a number of sites have been visited, it may be felt appropriate to forgo the lists and experiment with some of the search engines. However,

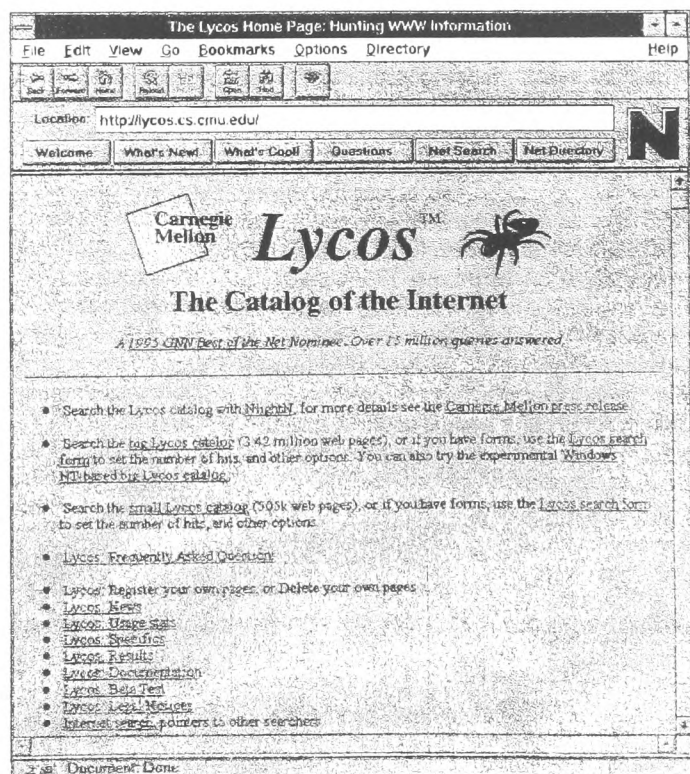


Figure 5: The Lycos Search Engine Home Page

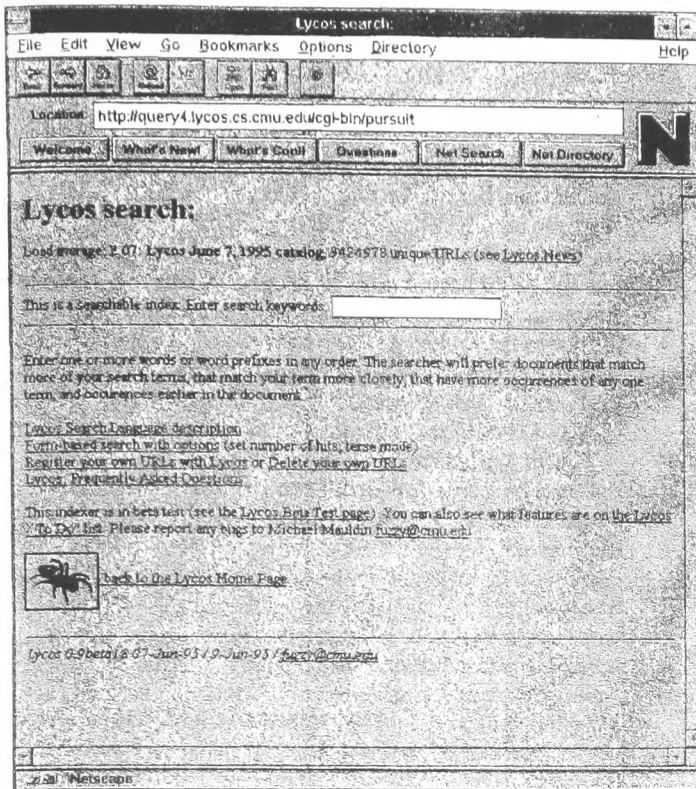


Figure 6: The Lycos Query Page

it would not be wise to make this move too early - too many worthless links will generally be identified in a search. And the whole process can become very unfulfilling, particularly if no relevant material had been seen previously. Far better to spend some time getting a feel for what is available from the lists, and then venturing to experiment with the search engines.

Useful places to start

For those that decide to explore the lists, there are many places where information can be obtained on World Wide Web. The home pages of academic departments would be useful places to start, many containing a number of useful links.

Educational resources are available by linking directly to institutions and searching their pages. However, very good and expanding lists of these resources do exist, the most prominent being: *The World Lecture Hall*: it currently (March 1995) has course materials from over 150 courses, and the number held is growing at the rate of 25 per month. (<http://www.utexas.edu/world/lecture>) Other more general education sites include: *The Global Campus* (<http://www.calpoly.edu:80/~delta>); *Edweb* (<http://edweb.cnidr.org/>); and *Peterson's Education Center* - a site where all the information on all the courses available at US colleges and universities is being constructed and maintained. (<http://www.petersons.com:8080/>)

Conclusion

This paper has demonstrated the alternative ways in which educators may become acquainted with and begin utilising the enormous information resources held in World Wide Web. It has considered a possible

scenario whereby failure to embrace the technology in teaching may have serious implications for the quality of teaching and student learning. And it has suggested that educators be proactive in seeking out the technology, learning about what it offers and experimenting with it in order to assess how it should be used. A number of starting points have been offered and material relevant to virtually all courses taught will be found at one or more of those locations.

The paper has not considered the research perspective, for which the potential of World Wide Web is, if anything, greater than its teaching potential. That is an issue that should be borne in mind whenever accessing World Wide Web: it is not a docile reference book, or an infrequently updated CD-ROM. It is a dynamic, constantly changing resource of immense potential to change the way we teach and the way we conduct research. If the academic community can grasp the resource early enough they will be better able to shape it for the future and everyone, academic and student alike will be the richer because of it.

References

- 1 AECC, Objectives of Education for Accountants: Position Statement Number One, *Issues in Accounting Education* 5, 307-312 (1990).
- 2 Mathews M.R., An examination of the work of the Accounting Education Change Commission 1989-1992, *Accounting Education* 3, pp193-204 (1994).
- 3 IFAC, *2000 and beyond*. IFAC, p5 (1994).
- 4 Network Wizards, *Internet domain survey: January 1995*, <http://www.nw.com/> (1995).
- 5 Lymer A., *The Internet and the World Wide Web in 1994: key changes and developments*, paper presented at the 6th CTI-AFM Annual Conference, Glasgow, (March 1995).

7. Sangster, A. and Mulligan, C. (1997), *Integrating the World Wide Web into an accounting systems course*, *Accounting Education, an international journal*, Vol. 6, No. 1, pp. 53-62. [80%]

Integrating the World Wide Web into an accounting systems course

ALAN SANGSTER¹ and CHRISTINA MULLIGAN¹

¹*The Queen's University of Belfast*

²*University of Aberdeen*

Received: March 1996

Revised: July 1996

Accepted: July 1996.

Abstract

The World Wide Web (the Web) presents a new dimension in the provision of information, not just for entertainment and for business, but also for education. This paper reports on the integration of e-mail and the Web into a third year accounting systems course. The Web was used both to supplant traditional lecture-based teaching and as the vehicle for a significant portion of the summative assessment on the course. e-mail was used for communication with the students, for submission to the tutors of their Web assignment and for feedback to the students on the assignment. Student views on the innovation are also reported and discussed.

Keywords: World Wide Web, Internet, e-mail, accounting systems.

Introduction

'IT is creating a wave of change that is crashing over accounting's shoreline. It crashed across industry in the 1970s. Then it crashed across the services in the 1980s. And it will crash across accounting in the 1990s' (Elliot, 1992, p. 61).

In his seminal paper, Elliot (1992), very much the accounting profession's spokesperson on these matters, discussed the changes in business decision making due to information technology (IT) changes. Such changes provide a challenge to academic accountants. They can choose to be reactive, changing as the need arises. Alternatively, they may be proactive, 'embracing the future, adapting rapidly, and facilitating the adaptations of others' (p. 85).

Users of information require accountants to provide up-to-date, timely and relevant information to aid in decision making. However, the trend towards centralized storage of financial as well as non-financial data, i.e. the accounting information system subsumed within the management information system, challenges the accountant's role as the primary provider of business information. Accounting and IT have had a difficult history and there are many within the academic community who regard IT as supplementary to the accounting discipline (Williams, 1991, p. 3).

*Address for correspondence: Alan Sangster, The Queen's School of Management, The Queen's University of Belfast, Lanyon Building, Belfast BT7 1NN, UK (e-mail: a. sangster@qub.ac.uk).

The World Wide Web and accounting education

The World Wide Web (the Web) represents a further challenge for both the accountant in practice and the academic accountant. Whilst the Internet has developed over the past 30 years, real growth in interest and in its use has occurred only during the last few years. Since the first freely available browser was made available in 1993, the Web's growth rate has been phenomenal (Lymer, 1995).

As an information resource, accounting educators can choose to ignore the Web at their peril – they face the problems of knowing how to find appropriate information, knowing how to use it and knowing what to tell students. If they are not proactive in acquiring these skills, they risk loss of face and prestige in the eyes of their students. At the extreme, they risk the loss of credibility from students who have used the Web as a source of information more topical, more advanced, more accurate or more appropriate than that they are being taught (Sangster, 1995).

From a student perspective, a search for information via library catalogues and CD-ROMs enables the development of skills in amassing relevant literature. Searching the wealth of material available on the Web adds to this process. It enhances the ability to select relevant information and to learn how to assess the quality of alternative sources and prepares the student for entering the changing work environment. It also provides students with skills in the use of an interface that will, in all likelihood, be the forerunner of the computer interface they will face throughout the early stages of their careers. Currently, there is a battle being waged between the traditional software providers, like Microsoft and the Web browser software companies. (A Web browser is software that is used to connect to the World Wide Web.) On its world-wide-web home page, Netscape, the leading browser, reported 45 million visits to its Web site per day in February 1996.

Many observers believe that the whole nature of computing is likely to change from an operating system/windows-based environment to a browser-based environment. Software (Formula One/NET) is already available that provides spreadsheet facilities within a Web browser. Quick View Plus lets you view, copy print and manage virtually any file from within a browser without launching (using) – or even having – the original application. It provides cross-platform support (that is, it allows programs to be used together that are normally only usable separately on completely different computer systems) for over 200 different types of word processor, spreadsheet, database, graphic and archive files, including HTML (Web page files), PKZIP (a commonly used file format that enables files to be stored in a compressed manner so as to save disc space) and UUE (a file format that enables files to be sent electronically between computer systems that can only process traditional text formats and cannot process 'binary' files – those that are in their original state, for example a Microsoft Word document is a binary file).

Examples of the use of the Internet in education/accounting education

IBM, in its Web page 'The Future of Technology in Education' (<http://www.multimedia.hosting.ibm.com/mmtoday/magazine/intro.html>) states that 'Information technology may not, in itself, be a panacea for education, but more and more experts believe it has a central and vital role to play in revolutionising education by providing tools for continuous, lifelong learning.'

Mendel Web (<http://www.netSPACE.org/MendelWeb/MWtoc.html>) is an example of a

hypermedia educational resource integrating elementary biology, discrete mathematics and the history of science. It has links to traditional reference materials as well as images, tutorials, active commentaries and animations. MendelWeb originated from a course taught at Columbia College, USA, on the theory and practice of science. One of the objectives of the course was to present science as an activity embedded in history. Whilst it succeeded in part, the multidisciplinary approach made text a difficult medium. Hence, a hypermedia approach (similar to the 'Help' facility in Microsoft Windows, where certain words are highlighted that, when clicked-on by the user, cause another page of information to appear) was taken to provide students with varying degrees and directions of interpretation and commentary. However, MendelWeb is not an on-line text. Rather, it represents an example of educational re-engineering that has led to the problems typically associated with the printed text not being transferred to its electronic format.

Another educational Web site, Edweb (<http://k12.cnidr.org:90/>), describes itself as a 'hyperbook' whose purpose is 'to explore the worlds of educational reform and information technology'. Visitors to the site can seek out on-line worldwide educational resources and examples of how technology is integrated into teaching. Other general education sites include The Global Campus (<http://www.calpoly.edu:80/~delta>).

Currently (July 1996), Web pages for 63 finance courses created by educators worldwide who are using the Web to deliver class materials can be found at http://www.cob.ohiostate.edu/dept/fin/resources_education/edcourse.htm. The World Lecture Hall (<http://www.utexas.edu/world/lecture/>) contains Web pages relating to 23 accountancy courses and nine finance courses. At both these sites, the material to be found on-line covers course syllabi, assignments, lecture notes, exams, class calendars and multimedia textbooks.

Two examples illustrate how the Internet is being integrated into courses.

1. The Web, e-mail and newsgroups (a form of e-mail where topics are presented and discussed electronically by members of a group) are integrated into the second level accounting course at the Fisher College of Business, Ohio State University. Students submit assignments and make queries via e-mail. Information relating to the course is also posted on an electronic newsgroup and on the course Web page. In addition, examples of exemplary student work are provided via the course Web page.
2. One of the objectives of the Accounting Concepts and Systems course at the University of Idaho is to emulate the modern professional workplace, achieving this objective through the use of a broad range of information management technologies, including the operation of a paperless classroom. Assignments are mainly submitted using electronic file transfer techniques and students are encouraged to communicate via e-mail. The enhancement of computer hardware and the application of software skills is a course objective, aimed at equipping students for a career which demands the ability to use technology to acquire, to assimilate and to distribute information efficiently and effectively.

The World Lecture Hall operates a registration system – if you wish your pages to be included, you need to notify them of the addresses of the Web pages. Many accounting-related courses exist that have not been registered with The World Lecture Hall. One, the Accounting Information Systems course at Oregon State University (OSU), was the inspiration for the authors' Accounting Systems course at the University of Aberdeen. The OSU course integrates the Web and e-mail and includes assignments for the students that require them to find Web sites of interest, create their own Web pages, review the Web pages of

other students and audit Web pages. Auditing a Web page includes ensuring that university standards have been followed and that the content accurately and fairly represents the topic, useful information skills to acquire as the Web grows in popularity in the business world.

The Accounting Systems course at the University of Aberdeen

*Background information*¹

The course is taken by students in their third year of study (<http://www.abdn.ac.uk/accountancy/cou3024.htm>). It includes within its list of course objectives the following:

- to instil a philosophy of continual learning;
- to develop an awareness of how to learn and how to adapt to or lead change;
- to develop an ability to seek-out information from whatever source(s) may be appropriate and to do so in a timely and effective manner;
- to develop the ability to collate and present information effectively in a useful form.

It would not be possible to achieve these objectives whilst ignoring the impact of the Web on the role of the accountant in practice. The 30 contact hours assigned to the 12 week course were divided between 12 hours of lectures, 12 computer laboratories and six tutorials. The lectures and tutorials were based on material from the textbook *Accounting, Information Technology, and Business Solutions* by Hollander *et al.* (1996). This text focuses on the *REAL* approach to accounting systems. The lectures covered the topics shown in Table 1.

During the weekly computer laboratories, students read through and took notes from 'Webnotes' (hypertext-based pages on material relevant to the course) – Table 2 – adapted from the Accounting Information Systems course at Oregon State University.

During the course, students were set an assignment relating to the Web (see Figure 1). Prior to attempting the assignment, they were advised to perform some preliminary work on the interface. Namely, they were to print the course syllabus, find a Web page relevant to the course and e-mail the details to the course tutors; they were then asked to prepare their own home page, publish it on the Web and send an e-mail to the tutors with the URL (Web address) of the page. To support the students in their work, they were encouraged to use

Table 1. Lecture topics

An introduction to accounting, IT and business solutions
Traditional accounting information system architecture
Modelling business processes
Prototyping an event-driven IT application
Business and information process rules, risks and controls
The sales/collection process
Other business processes
Business solutions, change and the solution professional: challenges and opportunities
The effect of IT on organizations

¹ The URLs for the course being described in this paper have been archived at <http://www.qub.ac.uk/mgt/alans/abdnais.htm>

Table 2. Index of Webnotes

1. Basic Computer Concepts – Review
2. Internal Control Concepts
3. Control of Computer-based Information System
4. Traditional Crime with a Computer Twist
5. Electronic Sabotage
6. Introduction to Artificial Intelligence and Expert Systems
7. Accounting Expert Systems Applications
8. Developing the Design for an Accounting System
9. Implementing an Accounting Systems Design

Downloaded By: [University of Aberdeen] At: 22:16 27 July 2008

e-mail to contact their tutors. Any questions or explanations that were of general interest to the class were made anonymous and circulated to everyone on the course.

The preliminary work was not assessed, being preparation for the assignment. The Web assignment contributed 30% to the final grade of the course. (The remaining 70% was based on a 2 hour closed-book examination.) As can be seen in Figure 1, all the students were assigned the same topic: to prepare a report on the use of the Web as an information resource in business. They were required to create a Web page containing their essay on the set topic, make it available on the Web and inform the course lecturers by e-mail of its URL by the end of week 10 of the course. They were advised to include appropriate pictures and links to other Web pages as well as bibliographic and other references. The length of the page was limited to 1000 words. In addition, students were requested to include in the body of the e-mail a short description of the page contents and a line of HTML code (the language of documents published on the Web) to facilitate placing the page on a page of links to all the projects (<http://www.abdn.ac.uk/acountancy/78htm.htm>).

The students were informed that their grade would be based on the following criteria:

- accuracy and completeness;
- organization and presentation;
- content;
- creativity;
- ease of update;
- properly referencing sources.

Assessment of the integration of the Web and e-mail into the Accounting Systems course
 Fifty four of the 63 students (86%) enrolled in the course completed a questionnaire at the end, similar to the one shown in the Appendix. The responses were encouraging given the background of the students and the fact that approximately 20% of them could be fairly described as computer illiterate at the start of the course. Thirty-four per cent found the computer laboratories to be unhelpful (i.e. responses in the 1 or 2 category). However, this was not unexpected. After an initial bout of hand holding, the students were encouraged to solve problems arising from the use of the software by themselves in order to improve their level of computer literacy. The responses are also not at odds with the spoon-feeding approach welcomed in general by the students, as evidenced in other courses.

The students were asked to comment on the integration of the Web into the course. Thirty-seven did so and a selection of their comments is shown in Table 3. While one student did say

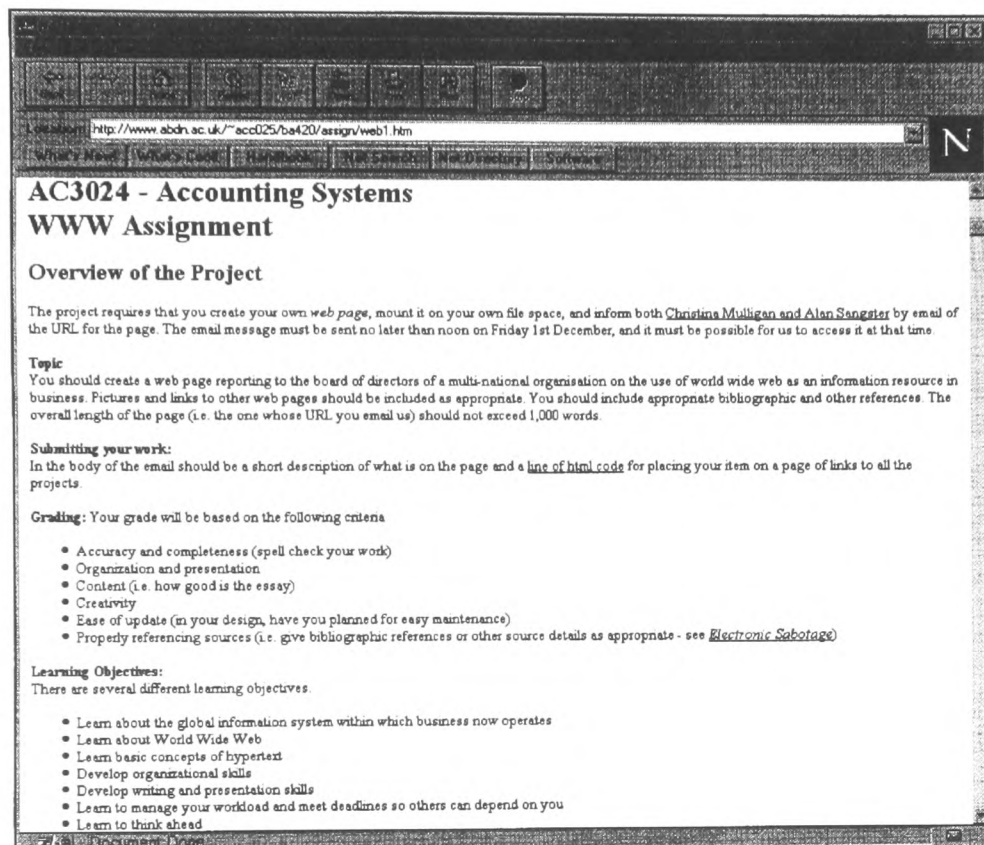


Fig. 1. The Web assignment

it was a 'waste of time' virtually all the comments were positive, the only other negative comments relating to a lack of guidance in how to use the Web – a not surprising criticism given that one of the aims had been to make the students learn for themselves. What was surprising was that so few made it and that many commented favourably on having been forced to find things out for themselves.

Although the students' attitudes towards the Web were positive overall, the Webnotes provided as supplementary material to the lecture notes were not perceived favourably. Only 20% of the respondents perceived them as helpful (responses in categories 4 and 5), 47% were indifferent and one-third did not consider them to be helpful. Question 5 produced slightly more positive results with 32% of the students who read them finding them worthwhile.

Considering that the majority of the students had not used e-mail previously and had to be shown how to use it during the first computer laboratory, the responses to question 3 were encouraging with 83% using it to send messages apart from submitting their Web assignment. Only 15% of the students did not find the e-mail messages sent to them from the course tutors helpful (question 7).

The most positive student feedback on the course related to the assignment to create a Web

Table 3. Samples of student comments on the integration of the Web into the course

Downloaded By: [University of Aberdeen] At: 22:16 27 July 2008	<p>It was very interesting and quite different from the other accountancy assignments, although very time-consuming</p> <p>Interesting and stimulating. Learned a lot</p> <p>Having established how to use the Internet and what could be achieved, it was interesting and informative and with hindsight I am glad we did do the project</p> <p>This project thoroughly enhanced my overall usage of IT systems. I feel that for the first time this course could be related to something outwith university!!</p> <p>This was definitely the most interesting thing that I have done during my entire 2½ years stay at the university. I used to think that I was fairly computer literate but it opened my eyes and allowed me to acquire skills which would certainly give me an edge over others when I enter my professional life</p> <p>It took ages getting simple graphics to work and you generally had to depend on friends to get the system to work. Having said that the handout on creating Web pages was very useful and on the whole the project was extremely interesting (compared with most accounting projects)</p> <p>Well worthwhile once we got into it but until then a complete pain in the neck. Most frustrating part of course when things refused to work</p> <p>We were thrown in at the deep end and it seemed to work</p> <p>Took a long time – frustrating – but at the same time quite satisfying. The Web has a huge capability to distract you</p> <p>I got carried away with the Web project. It was good fun actually</p> <p>Very useful, interesting</p> <p>Worthwhile doing the project as it was interesting and different to other projects we have had to do. Actually enjoyed working on it</p>
--	--

page. Two-thirds of the students felt that creating the page was a worthwhile exercise, with only 6% considering it not to have been so. Some students complained about the difficulty of the project in e-mail messages during the weeks leading up to the submission deadline. When investigated, these were generally the same students who had not completed the first part of the assignment (to build their own home page). (This was non-compulsory, i.e. students could choose not to do it without any penalty.) One student went so far as to state on the end of course questionnaire that this was the first time a course had seemed relevant to something outwith university – see Table 3.

Eighty-nine per cent found the use of the Web interesting (question 8), a response which should be considered in light of the fact that accounting systems is the subject that accounting students everywhere generally dislike the most.

All respondents felt able to assess the usefulness of the Web to them – 68% believing it had been. This does not contradict the word from the American academic community which indicates that proficiency in the Web impresses recruiters and helps students to find jobs. Fifty per cent of the respondents used the Web to source material for other courses. Given that only 19% had seen the Web before starting the course, 15% having used it, this is also encouraging. The enthusiasm of the respondents for the Web as a medium is noted by the fact that 94% of the respondents would recommend its use to the following year's students.

Conclusions

The integration of the Web into the Accounting Systems course at Aberdeen University was well-received by students and significantly improved their rating of the course compared to those of previous years – 70% felt the course was interesting and stimulating compared to only 40% the previous year. By exposing the students to the technology and forcing them to use it, they were made aware of the potential and immensity of the information resource that the Web represents. As a result, they completed the course better prepared for the world outside university and better equipped to cope with the changes that they will experience around them as they proceed with their careers as the accountants of tomorrow.

However, despite the clear benefits of this form of integration, one student's comments concerning the course as a whole reveals an inherent problem that advocates of the integration of the Internet into their teaching will undoubtedly face: 'I feel the course has been trivial and, even although I find the concepts quite hard to grasp, I feel my preparation for accounting would be better aided by more *relevant* stuff. I know technology will be the future, but "more oft I shall beseech thee to use a scribe..."' It would be unfortunate were minority views of this type to hinder the development of courses in this direction.

The IT environment is moving very rapidly and the impact of these technologies upon teaching and research is likely to be far-reaching and permanent. Those who do not embrace technologies like the Web in an appropriate manner will be ever more likely to find themselves being left behind by their more IT-literate colleagues. Companies and firms are rapidly embracing these technologies with a major adoption of organizational Intranets (internal Web networks) and students who are not exposed to these technologies will become increasingly less attractive to industry and the profession in the years ahead. Further work is urgently needed in order to assess how best to integrate these technologies into academic practice – not just for teaching, but also for research.

There are many hundreds of accounting-related Web pages, many of which contain links to a vast number of relevant information resources. Many of these are being collated and signposted by the International Accounting Network at such sites as the ICAEW pages (<http://www.icaew.org.uk/>). There are also some large collections of links maintained privately on the Web (such as <http://www.offshore.net/accs.htm> and <http://www.uni.edu/schmidt/account.html>). The raw material is available, all that is required is that accounting educators start looking at it and considering how best to use it.

... whatever the eventual status and use of the Internet turns out to be, if it is seen as merely a way to do what educationalists do now, only quicker, then it is clear that an opportunity is being missed. If instead, it is seen as a way to radically change the whole idea of education ... [with the technological resources enabling education to become 'learning' rather than 'teaching'] ... then we have a far more exciting prospect before us (Pickering, 1995, p. 10).

The authors' experience on this course certainly echoes the view that future prospects are exciting, both for the educators and for their students.

References

- Elliot, R.K. (1992) The third wave breaks on the shores of accounting, *Accounting Horizons* 6(2), 61–85.
- Hollander, A.S., Denna, E.L. and Cherrington, J.O. (1996) *Accounting, Information Technology, and Business Solutions*, Irwin: Chicago.
- Lymer, A. (1995) The Internet and the World Wide Web in 1994: key changes and developments. In

Selected Proceedings 6th Annual CFI-AFM Conference, Glasgow, UEA: Norwich.

Pickering, J. (1995) Teaching on the Internet is learning, *Active Learning* **2**, 9–12.

Sangster, A. (1995) World Wide Web – what it can do for education?, *Active Learning* **2**, 3–8.

Williams, B.C. (1991) The impact of IT on basic accounting concepts and accountancy education: an overview. In *IT and Accounting: the Impact of Information Technology* (edited by B.C. Williams and B.J. Spaul). London: Chapman & Hall, 1-16.

Appendix: World Wide Web Questionnaire Responses

Downloaded By: [University of Aberdeen] At: 22:16 27 July 2008

1	Generally, how helpful were the computer laboratories (from 5=very helpful to 1=not helpful) ($\mu=2.94$)	5 # 2 4%	4 # 13 24%	3 # 21 39%	2 # 16 30%	1 # 2 4%	Do not know # 0
2	Generally, how helpful were the Webnotes in enhancing your understanding of accounting systems (from 5=very helpful to 1=not helpful) ($\mu=2.87$)	5 # 2 4%	4 # 7 16%	3 # 21 47%	2 # 13 29%	1 # 2 4%	Do not know # 9
3	Apart from using it to submit your Web assignment, did you use the e-mail system to send messages? ($\mu=0.83$)	Yes # 45 83%			No # 9 17%		
4	Did you use the Web to source material for other courses? ($\mu=0.5$)	Yes # 27 50%			No # 27 50%		
5	Was it worthwhile providing the Webnotes? (from 5=very worthwhile to 1=not at all worthwhile) ($\mu=3.20$)	5 # 4 8%	4 # 12 24%	3 # 23 47%	2 # 10 20%	1 # 0	Did not read them # 6
6	Was the assignment to create a web page a worthwhile exercise? (from 5=very worthwhile to 1=not at all worthwhile) ($\mu=3.85$)	5 # 15 28%	4 # 20 38%	3 # 15 28%	2 # 1 2%	1 # 2 4%	Do not know # 1
7	How helpful did you find the e-mail messages sent to you concerning accounting systems? ($\mu=3.58$)	5 # 14 26%	4 # 14 26%	3 # 17 32%	2 # 5 9%	1 # 3	Did not read them # 1
8	How interesting was it to use the Web in this course? (from 5=very interesting to 1=not interesting) ($\mu=4.17$)	5 # 22 41%	4 # 26 48%	3 # 2 4%	2 # 1 2%	1 # 3 6%	Do not know # 0
9	Overall how useful do you feel use of the Web has been to you (from 5=very useful to 1=not at all useful) ($\mu=3.83$)	5 # 12 22%	4 # 25 46%	3 # 14 26%	2 # 2 4%	1 # 1 2%	Do not know # 0
10	Would you recommend the Web to next year's new students? ($\mu=0.94$)	Yes # 51 94%			No # 3 6%		
11	Had you seen the Web before starting this course? ($\mu=0.19$)	Yes # 10 19%			No # 44 81%		
12	Had you used the Web before? ($\mu=0.15$)	Yes # 8 15%			No # 46 85%		
13	If you were planning the course, how many of each of the three forms of classes would you include – there are 30 hours in total and this year it was 12 lectures plus 12 computer laboratories plus six tutorials=30 in total				μ Lectures 13 Computer laboratories 9 Tutorials 8 30		

8. Sangster, A. and Lymer, A. (1998), *How to survive a new educational era*, Issues in Accounting Education, Vol. 13, No. 4, pp. 1095-1109. [80%]

EDUCATORS' FORUM

How to Survive a New Educational Era

Alan Sangster and Andrew Lymer

ABSTRACT: A number of authors foretell the dawning of a new era in higher education, an era involving a technological and structural redefining of the environment, a reshaping of the nature of institutions and of the market, and a transformation in the nature of the role of faculty. Underpinning many of these views is the present and potential impact of the Internet, particularly the World Wide Web and the resulting opportunities for new approaches to delivering and managing the educational process.

These opportunities are already evident. While the establishment and successful operation of virtual universities might still appear to many to be in the realms of science fiction, there are already some fledgling examples in existence. The presence of virtual modules and degree courses is a reality, along with a growth in the extent of the integration of Internet technology within existing courses.

This paper concentrates on the World Wide Web as a basis for these forecasts of a new educational era. It describes how the *web* is currently used in education focusing, where appropriate, upon its use in accounting and finance education. It presents views on educational use of the technology, pointers to a range of web-related developments and indications of the wealth of support available on the Internet for integrating World Wide Web into the curriculum. Wherever appropriate, the focus switches from general educational issues to specific accounting and finance ones.

INTRODUCTION

The March 1997 issue of *Accounting Horizons* included a view of the structure of higher education within a decade that differs markedly from how we know it today:

Not only will many traditional business schools not survive, but the role of the...professor will be fundamentally different from what it is today....Schools and professors...will face a competitive market in which all the rules of the game are changed.

Shifting demands of global corporations, leaps in technology and an emerging challenger—the corporate university—will all affect these rules in fundamental ways. (Moore 1997, 77)

While the focus of Moore's (1997) paper was upon the threat posed by corporate universities to business schools, one of the factors

Alan Sangster is a Professor at Queen's University of Belfast, U.K. and Andrew Lymer is at the University of Birmingham, U.K.

underpinning the author's view concerning the immediacy of the threat was the availability of *advanced technologies* to provide opportunities for change in the way in which education is conducted.

This paper is concerned with the implications of one particular advanced technology, the World Wide Web, for higher education and, in particular, for accounting and finance education. Aside from any threat from corporate universities, the educational environment is undergoing a technology-driven shift of unparalleled proportions. Traditional higher education, campus-based with its focus upon the physical delivery of material to students from tutors, is losing its grip on the educational process. Some already say that universities, departments, courses and faculty must adapt to this changing environment or sink slowly into obscurity:

We are moving from our existing Industrial Age model for education to a learning vision for the 21st century—a vision that is fundamentally realigned with the needs of learners in the Information Age. The pathway from the existing world, where colleges and universities substantially own the teaching franchise, leads to a world where the learning franchise is spread among many providers and new types of facilitators, learning agents, and intermediaries. This new world holds greater competition and more choices—and substantial opportunities to serve legions of Information Age learners Those who realign their practices most effectively to Information Age standards will reap substantial benefits. Those who do not will be replaced or diminished by more nimble com-

petitors. (Dolence and Norris 1995)¹

Twelve thousand copies of the book from which this quote comes were sold within four months of publication, suggesting a high level of interest in the topic. Educators worldwide reacted positively to it, often using the very technology seen as likely to spearhead this environmental shift—the World Wide Web—to awaken colleagues to its implications. One example is a workshop, *Expanding Opportunities for Learning in the Information Age*, available on the web and presented to faculty at South Africa's UNISA—one of the world's largest universities, with over 130,000 students—on September 27, 1996.²

Some recent commentary, echoing to some degree Moore's (1997) views, is even more pessimistic concerning the future of the current educational world than Dolence and Norris (1995):

Thirty years from now the big university campuses will be relics. Universities won't survive. It's as large a change as when we first got the printed book. Do you realize that the cost of higher education has risen as fast as the cost of health care?...Such totally uncontrollable expenditures, without any visible improvement in either the content or the quality of education, means that the system is rapidly becoming untenable. Higher education is in deep crisis....Already we are beginning to deliver more lectures and classes off campus via satellite or two-way video at a fraction of the cost. The college

¹ <http://141.211.140.236/catalog/catalog.htm>

² <http://www.unisa.ac.za/webuc/index.htm>

won't survive as a residential institution. (Drucker 1997)³

These quotations present a specific view on the future impact of technology upon the delivery of education. The literature on the use of technology in higher education partly supports and partly questions this viewpoint. For example, Anderson et al. (1981) examined the use of microcomputers in science instruction focusing on how students learn from computers. This was one of the first of a large body of literature suggesting that beneficial effects on learning result from both brief and more lengthy use of computers for learning support. They illustrate the value of novelty and of the exploratory nature of the learning experience that a computer can be used to create. Used effectively, the World Wide Web can create both a novel and an exploratory learning experience.

Human-processing capacity is one issue raised by critics of the viewpoints expressed by Moore (1997), Dolence and Norris (1995) and Drucker (1997). Weick (1985) addresses it in the context of greater I.T. use in managerial roles and suggests that the limits of an individual's processing capacity should be an important consideration in planning tasks involving electronic information processing. Similarly, it should not be ignored when planning courses and programs in higher education delivered with and through greater use of technology. However, Weick (1985) argues that human-processing capacity can be expanded and therefore be less of a constraint, if the right context is developed within which the I.T. is used. Ives and Jarvenpaa (1996, 35) suggest changes in the context of education can be expected that are compatible with Weick's (1985) argument. These

changes point to the necessity for technological support, such as provided by the World Wide Web, and include:

- increases in virtual learning communities where teacher and student do not share the same physical space;
- "pull" (i.e., student-demanded) rather than 'push' (i.e., tutor-selected), with students doing more of the structuring of their own education;
- lifelong learning—leading to flexibility in learning options including closer collaboration with business in education delivery;
- just-in-time (i.e., what the student needs when needed) rather than just-in-case (i.e., what the student might need) education—models of timely delivery of education will be demanded by students;
- demonstrated skill rather than certification—testing of skills via application rather than recall;
- global collaboration—increasing demand for students to collaborate with other students from other places around the world;
- open competition—students will be more able to compare global education opportunities than ever before.

In the accounting literature, for many years there has been a debate concerning automation of education and the role of information technology. Gordon (1962) discussed these issues and raised similar concerns to those faced today, including pressure to continually improve teaching methods, the desire to minimize cost of course delivery, the need to maximize the efficiency of the "learning

³ <http://www.forbes.com/forbes/97/0310/5905122a.htm>

experience" and what should be the role for face-to-face contact between faculty and students.

Gordon (1962) suggested that "it is reasonable to conclude that programmed instruction can help students learn more effectively"; and referred to four constituent learning principles:

- 1) the student should participate continuously in the learning process;
- 2) individual differences should be recognized and the student should be permitted to go at his own speed;
- 3) students should be informed immediately of the correctness of their response; and,
- 4) it should be possible for students to achieve a high degree of success as they progress through the learning program.

These principles can be addressed through the development of I.T. in the accounting program and have been adopted in the subsequent accounting literature as guides to the role of the computer (e.g., Scribner 1990).

Groomer (1981, 940) assessed the value of a computerized introductory accounting module as an effective tutorial medium in support of traditional learning techniques. He concluded that with the proper software the computer is a "tireless and ever available vehicle to provide the tutorial assistance that a student needs."

Fetter et al. (1986) report similar results when integrating computers into an intermediate accounting course. A number of other papers have addressed the role of the computer in accounting education and reported predominantly positive re-

sults (for example, Thomas 1983; Helmi 1986; Abraham et al. 1987; Kachelmeier et al. 1992; Sangster 1992).

Borthick and Clark (1987) raised doubts concerning some of the reported advantages gained from computer integration in accounting education. They discussed, for example, the Hawthorne effect (also mentioned by Groomer 1981) as a possible explanation for improved performance with computer use; and the self-selection bias problem, where better students may volunteer to use the computer where weaker students will not. Others have subsequently reported similar concerns over the use of the computer as a learning tool (including McInnes et al. 1995) or mixed results for different cognitive abilities (including Ruf et al. 1994).

There is a wealth of accumulated knowledge and expertise on the integration of I.T. both within education in general and at the level of specific disciplines, such as accounting and finance. But, despite this large body of knowledge, the extent of reaction to the I.T.-driven changing educational environment varies from country to country, institution to institution and discipline to discipline.

Within accounting, although a search of the World Wide Web reveals that some faculty are embracing web technology, the majority are not. Debrecey et al. (1996), in a survey of 300 U.S. accounting faculty, reported a positive attitude toward the use of the Internet in the classroom, with 70 percent of respondents using the Internet in some fashion. Principle use among respondents was, however, of email rather than the web. Sixty-two percent of respondents indicated that lack of training was a barrier to use of web

technology. Fifty-eight percent indicated that lack of knowledge about the Internet in general was a further barrier; and 60 percent indicated that they had an interest in learning more about its potential usefulness.

They concluded that there was a significant need for further training of educators in applying web technology in the classroom. The American Accounting Association has responded to this need, supporting CPE courses in this area at the 1996 and 1997 annual meetings. Similarly, the European Accounting Association had a workshop on this subject at its annual Congress in 1997. However, many accounting faculty and departments have, to date, ignored the technology and run the risk of ignoring it for so long that students go elsewhere, preferring departments where information concerning their courses is readily available on the World Wide Web.

The rest of this paper reviews the development of this new educational environment. It focuses on the features of the World Wide Web and on the way it has been embraced and integrated into education in general and in accounting and finance education in particular. Views on educational use of the technology are presented, along with pointers to how prospective integrators might embrace the technology in a meaningful and positive way, including the wealth of support available on the Internet to anyone pursuing its integration.

BACKGROUND

Between 1993 and 1997, the World Wide Web developed from virtually a zero base (130 web sites⁴ in June 1993) to a position where, in January 1997, there were an estimated 650,000 web sites (Gray 1996).

A review of the features of the World Wide Web provides a clear indicator of why the technology could be attractive to educators:⁵

- 24 hour access, 365 days a year;
- (subject to having the appropriate equipment) accessible by anyone, anywhere, as easily as if they were in the same room as the person who created the material;
- access can be restricted to particular individuals, class members, or a defined community, such as an entire university or potential students;
- seamless integration of text, graphics, video and sound;
- direct access to other resources, primary sources and other materials from around the world (e.g., Library of Congress, AICPA, FASB, IRS, educational materials, etc.);
- unlimited scale—subject to consideration of copyright, the author has complete freedom in the extent and growth rate of the material;
- easy and immediate update of material ensures that users (e.g., students) may always see the latest version of the material;
- while some HTML programming skills may be required for sophisticated web page development, such as pages with embedded multimedia, a very short learning curve in web page authorship makes it generally easy to develop straightforward material and place it on the web—for example, it would take six mouse clicks to convert this paper

⁴ As defined by Matthew Gray of MIT, web sites are all documents with URLs beginning with a unique hostname. That is, <http://www.mit.edu/people/mkgray/> and <http://www.mit.edu/madlibs> are part of the same site, but a document <http://web.mit.edu/> is a separate site.

⁵ Expanded from Weil (1996a).

into a web page and publish it on the web.

Individual Modules

Educators who perceive educational benefits in adoption of the technology have employed it to develop and deliver educational materials.

The extent and range of these educational materials can be seen from meta sites of collections of web-based educator materials.⁶ Perhaps the best known of these is the *World Lecture Hall*,⁷ a structured database of links to teaching materials across all disciplines, listed by discipline and then module topic. It contains links to material on over 1,350 modules, including 36 accounting and 20 finance modules. Another multi-disciplinary meta site, *Teaching and Learning on the Web*,⁸ contains a database of over 500 sites, including 13 accounting and finance links.

An obvious place for accounting and finance faculty to seek out educational resources is the Rutgers University web site, where much of the AAA web material is maintained. It contains links to home pages of 18 U.S. accounting faculty actively developing web-based course materials.⁹ However, as can be seen by reviewing the contents of accounting- and finance-focused single-discipline meta sites, many other accounting and finance faculty are integrating the technology into their teaching. Three such accounting and finance meta sites which together contain links to material from over 200 different accounting and finance modules are:

- *Accounting Academia*¹⁰—65 accounting modules (list maintained by Dennis Schmidt, University of Northern Iowa)
- *Tax Academia*¹¹—43 tax modules (list also maintained by Dennis

Schmidt, University of Northern Iowa)

- *Finance Courses on the Web*¹²—128 modules (75 undergraduate, 41 M.B.A. and 12 Ph.D.)

Table 1 reveals a wide range of content among 100 of these sites—50 accounting and 50 finance.

Although a few of the sites restrict access to lecture material, most offer unrestricted access to virtually everything except student grades. While table 1 suggests similar types of developments in each of the domains, the Finance Ph.D. pages contain extensive reading lists. The Finance pages also include video¹³ and graphical interactive exercises written in Java.¹⁴

The existence of so much material suggests that changes to the accounting and finance educational environment have already taken place and/or are in the process of taking place:

- there already exists sufficient material in electronic form—syllabi, reading lists, assignments, etc.—to make it unnecessary for anyone in the foreseeable future to prepare a new accounting or finance module unaided.

⁶ All web page content descriptions are as at April 5, 1997; URLs amended for changes to June 24, 1998.

⁷ <http://www.utexas.edu/world/lecture>

⁸ <http://www.mcli.dist.maricopa.edu/tl/>

⁹ <http://www.rutgers.edu/Accounting/raw/internet/teach.htm>

¹⁰ <http://www.taxsites.com/academia.html#courses2>

¹¹ <http://www.taxsites.com/academia.html#courses>

¹² http://www.cob.ohio-state.edu/dept/fin/resources_education/edcourse.htm

¹³ http://www.cob.ohio-state.edu/~fin/resources_education/clips.htm

¹⁴ http://www.duke.edu/~charvey/Classes/ba350_1997/350index.htm

TABLE 1
Resources Available at 100 Web Sites

	<u>Accounting (50)</u>		<u>Finance (50)</u>		<u>Overall</u>
	<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>	<u>%</u>
Syllabus outlines	46	92	45	90	91
Module timetables	33	66	31	62	64
HTML lecture notes	4	8	11	22	15
Wordprocessed lecture notes	5	10	6	12	11
HTML overheads	5	10	1	2	6
Powerpoint overheads	11	22	2	4	13
Additional notes	22	44	7	14	29
Downloadable spreadsheets and/or databases	9	18	8	16	17
Web resource links	28	56	22	44	50
Assignments	27	54	22	44	49
Objective tests	5	10	12	24	17
Exam questions	11	22	18	36	29
Solutions	12	24	18	36	30
Examples of student work	5	10	3	6	8
Module discussion lists	9	18	5	10	14

- the existence of so many module role models and so many champions of the use of web technology presently promoting its adoption and integration into accounting and finance education suggests that the necessary supporting infrastructure is already in place to underpin a rapidly increasing adoption of the technology among accounting and finance faculty.
- prospective students can obtain far more details concerning courses they may be interested in taking than was previously the case, opening the way for far more informed selection of institution, program and individual modules; and can do so at any time and from anywhere with a connection to the Internet.
- students attending modules assessed solely by end-of-module assessment need not attend classes or purchase textbooks in order to pass the assessments in many of the accounting and finance subject areas. Instead, they can follow the material of similar modules published on the web.
- the wealth of online material also supports the Dolence and Norris (1995), Moore (1997) and Drucker (1997) scenarios making it possible—subject to consideration of copyright—for modules, even entire programs to be developed by a far smaller faculty base than is currently the norm, enabling new institutions to form and compete for students, even with those institutions whose faculty designed the material on which their modules and programs are based.

Further support for these scenarios can be found in other activities on the World Wide Web, including CPE courses, short courses, online degrees, virtual universities

and academic-corporate joint initiatives. While good examples exist of accounting and finance web-based CPE courses, for short courses, online degree programs and joint initiatives, a more complete picture is obtained by looking at what is happening in education in general, rather than by maintaining the focus upon accounting and finance education.

CPE Courses

Developments are not restricted to the higher education sector. Courses are available on the web that carry AICPA CPE credit. For example, *The Rose Engagement*,¹⁵ an auditing case study, is available either online or as a hard-copy self-study pack. The following description is to be found at its web site:

The course introduction, first lesson (narrative and examination) as well as the first three chapters of the *Rose Engagement* novel (case study) are available at this web site. Support is available via Internet electronic mail. Once you have purchased the course, the remaining chapters of the novel (case study) will be sent to you by email at the rate of one per day. You will also receive the remaining three lessons at appropriate times during the following 31 days as you are receiving chapters of the case study.

You will complete an examination at the end of each lesson that you will return via email. Feedback on your answers and answers to requests for help will be promptly returned by your mentor.

The enrollment cost is \$59 for the online version, \$79 for the paper version.

Short Courses

One of the most impressive all-round resources in this area is the *Virtual Education Sites* list¹⁶ maintained by Roy Rada as part of his *Virtual University* computer science module¹⁷ at Washington State University. Among these pages, is one describing three mini-courses at The Gallup Organization in 1996.¹⁸

What was special about the courses is that all were offered in virtual mode. There were no face-to-face meetings. Participants were distributed across the globe—typically half the participants were distributed evenly across Europe, South America and Asia—each course had about 23 participants. The WWW site used clickable image maps, frames, interactive forms, registration facilities, discussion facilities, search tools and so on. The response of participants was positive.¹⁹

Online Degree Programs

The next step after individual modules appear on the web is for complete degree programs to become web-based. This has progressed to the point that complete degree programs are offered over the web. Some can be found from resource list web pages, their authors clearly ignoring the possibility that providing such information may lead to prospective students going elsewhere. One, for example, maintained at the University of North Carolina,

¹⁵ <http://www.kentis.com/rose/rose.html>

¹⁶ http://134.121.242.55/public_virtual/content/sites.htm

¹⁷ <http://radamain.eecs.wsu.edu/cs570/passwd/password.asp>

¹⁸ <http://www.eecs.wsu.edu/~rada/cv/teach/teach.htm>

¹⁹ <http://134.121.242.55/gallup/>

presents a number of links to these and other related pages.²⁰ These links include one to the Western Governors University,²¹ created through an initiative by the Governors of 16 western states of the U.S. and Guam. Offering courses from early 1998, it will collaborate both nationally and internationally in the delivery of educational programs. Among its international collaborators are the U.K. Open University, the Open Learning Agency in British Columbia, Canada and the Tokai University Educational System in Japan.²² It will not hire faculty, all instruction coming from institutions of higher education and nontraditional providers of education services.

In terms of the web presence of modules, the *Globewide Network Academy*,²³ a nonprofit organization based in Austin, Texas has pointers, rather than live links, to over 10,000 module and degree program web pages. These include 20 accounting programs and 211 accounting modules, and 11 Finance programs and 88 Finance modules.

The *Internet University*²⁴ site has almost 1,000 individual pages of information about online college courses available on the Internet. It is the companion site for a book, *The Internet University: College Courses by Computer* (Corrigan 1996), published by Cape Software. Among its web pages are contact details of over 700 online modules,²⁵ including 50 that are business related. It lists 29 universities providing online modules.²⁶

Joint Initiatives

Academic-Corporate cooperation is also embracing web technology. For example, the *British Airports Authority* is launching a corporate M.B.A., DMS and CMS with the University of Surrey where

course material will be made available over the web (Skapinker 1997). *British Aerospace* is establishing a virtual corporate university. It will offer employees the opportunity to use electronic communication to study for the complete range of academic qualifications, including Ph.D.s.; and it is willing to make its courses available to other universities (Anonymous 1997). The *Western Governors University* was established with the help of grants that included \$500,000 from 3Com Corporation; \$250,000 from each AT&T, Apple Computer Inc. and International Thompson Publishing; \$350,000 in services from IBM; and \$100,000 from each of the states supporting it.

With over 200,000 students, the U.K.'s distance-learning-based *Open University*²⁷ is a leader in the use of technology in its teaching. It first combined with the British Broadcasting Corporation to transmit TV programs containing course material in 1971. In February 1997, it began offering an entire master's degree in Open and Distance Education²⁸ over the Internet. It collaborated with two Australian universities, Deakin University and the University of South Australia, in the preparation of some of the teaching materials. In April 1997, it launched the *Business Cafe*.²⁹

²⁰ <http://www.iat.unc.edu/guides/irg-38.htm>

²¹ <http://www.westgov.org/smart/vu/vu.htm>

²² <http://www.westgov.org/smart/vu/news/aug97.htm>

²³ <http://cgi.gnacadeemy.org:1089/cgi-bin/frontpage.cgi>

²⁴ <http://www.caso.com>

²⁵ <http://www.caso.com/iu/courses.htm>

²⁶ <http://www.caso.com/iu/providers.htm>

²⁷ <http://www.open.ac.uk/OU/Intro/FactsAndFigures.htm>

²⁸ <http://www-iet.open.ac.uk/iet/MA/MA-IN-ODE.htm>

²⁹ <http://oubs.open.ac.uk/businesscafe/>

The entry web page describes the *Business Cafe* as:

the very first business program to be broadcast to you through the web as well as through television. This webcast will supply you with a specially edited nonlinear interactive version of *The Business Cafe* program which is broadcast to you on Sunday mornings at 7.25 am on BBC2.

The Open University, supported by Sun Microsystems, Apple Computer and IBM has also developed *KMi Stadium*,³⁰ a web-based interactive lecture theater capable of simultaneously collating the inputs of up to 100,000 students. It combines audio and graphics to simulate a lecture presentation and can present online feedback to questions posed by students while the lecture is in progress.

Overall

There is evidence that an infrastructure is developing that supports the ultimate realization of the Dolence and Norris (1995), Moore (1997) and Drucker (1997) scenarios:

- modules and courses are being developed and placed online
- faculty are proactively and independently integrating web technology into their teaching
- meta lists are in place, making it relatively easy for newcomers to find role models and to identify "best" practice
- professional bodies—for example, the AICPA—are accrediting online courses
- short courses are being run online in the business sector
- whole degree courses are being provided online by, for example, the U.K. Open University

- virtual universities—for example, the Western Governors University and the Online Campus of the University of Phoenix³¹—are being established, funded by corporate and private donation and public money
- software exists—for example, *KMi Stadium*—that enables both synchronous and asynchronous communication of material

However, some potential impediments may affect the educational adoption and impact of technology:

- difficulties in gaining access to web file space may discourage instructors from using the technology.
- while many campuses will provide students with access to the Internet that, in theory, creates for them the environment in which they can exploit this technology, few currently maintain enough access points for a greatly increased level of student demand.
- the cost of "off campus" access to materials must also be considered. The provision of web-based materials will enable students to have wider access to teaching resources than may have traditionally been the case. However, this will require support both technically and physically, and will be likely to be costly for students when accessing the materials by any means other than local calls. In addition, students require appropriate hardware and software, the cost of which may not be trivial in some cases to the student concerned.
- the proposed U.S. Digital Millennium Copyright Act would place broadly equivalent copyright legislation upon U.S. web-based material as currently applies to other

³⁰ <http://kmi.open.ac.uk/stadium/>

³¹ <http://www.uophx.edu/online/>

forms of publication. However, copyright law as of June 1998 is unclear concerning the use of other people's web-based materials.³² Current accepted practice among academics is to waive intellectual property rights for materials posted on the web, but some instructors may be reluctant to create links to such material in case they would infringe copyright by doing so. They may also be reluctant to place their own material on the web if they are unsure whether it infringes copyright.

- the risk-averse nature of accountants may cause the market for accounting education to reject the use of web technology until they are convinced that it has been shown to be appropriate for educational use. Research into the effects of web-based instruction upon learning is in its infancy and it may be some time until a substantial body of evidence, whether it is supportive or nonsupportive, exists.

Whether the educational environment transforms from its traditional basis, plus some extension toward an IT-based facility, into one that is largely technology-based, depends upon a suitable environmental infrastructure. It also depends upon these potential impediments being overcome and upon students being comfortable with the shift. Evidence to date supports the view that the current generation of students is comfortable with a web-technology-based approach—see, for example, Weil (1996b), Rada (1996), Sangster and Mulligan (1997). Given that students are certain to be increasingly IT-literate, the acceptance by students of a greatly enhanced level of technology integration into educa-

tion is not going to be an issue in the 21st century.

WHERE TO START

Change is occurring and likely to continue. Faculty and institutions need to consider how they should respond. Prospective educational adopters of web technology can find assistance from a range of sources. They can also make use of teaching material already on the web to enhance or assist the development of their own instructional resources.

On-line Assistance for Integrators of Web Technology Into Accounting and Finance Education

Examples of the range of online assistance available include:

- Advice on how to undertake the development of such materials is available from over 100 accounting and finance academics who have already "been there," all of whom can be contacted via email links on their module web pages.
- There are numerous web sites containing advice on integrating web technology into education. From an accounting perspective, perhaps one of the most comprehensive and helpful is that of Professor Bob Jensen at Trinity University.³³
- The Yahoo hierarchical database has a collection of links useful to integrators of web technology under *Education: Instructional Technology: On-line Teaching and Learning: Teacher Resources*.³⁴

³² See, for example, <http://www.tht.com/VUartF96copyright.htm>

³³ <http://WWW.Trinity.Edu:80/~rjensen/>

³⁴ http://www.yahoo.co.uk/Education/Instructional_Technology/Online_Teaching_and_Learning/Teacher_Resources/

- The AECM-L email discussion list run by Barry Rice at Loyola College in Maryland³⁵ has over 775 subscribers and often has topic threads relating to this subject.
- *TopClass*³⁶ web-based training software includes a virtual classroom, material preparation, communication, assessment, feedback and student management utilities. A trial version is available from the web site, as are examples and reports of installations in the U.S., Europe and Australasia.
- The University of Illinois has created an intelligent student-computer interface, *CyberProf*.³⁷ It consists of several modules and is freely available to any nonprofit academic client under a beta-test arrangement:

Using *CyberProf*, instructors can create online lecture notes that include equations, animations and graphics; write online interactive homework problems; conference with students using Network TA, the *CyberProf* Web-based bulletin board system; survey students and receive feedback on course material; and record student grades in the *CyberProf* online gradebook.

Students can review lecture notes 24 hours a day; complete homework problems on the Web and receive immediate intelligent feedback on their answers; use the Network TA bulletin board system to post questions to their instructor, teaching assistants, and peers; and review their grades in the class at any time.

The *Business Finance* module³⁸ at Northwest Missouri State University is an example of a module that uses *CyberProf*.

- From another perspective, the Nottingham Trent University *Business Applications* of the Internet module web page³⁹ shows how the technology can be integrated into a module that is designed to illustrate the breadth of use and power of the Internet to business studies students. It combines external links and links to web-page-based lecture slides, essay assignment details, project assignment options, web authoring advice and a class discussion list.

Features that can be Readily Incorporated from Current Web-Based Material

- Relevant articles can be found on the Internet and linked into an "articles" web page—the *articles* page⁴⁰ maintained by J. David Spiceland at the University of Memphis has 24 web articles linked to chapters in the recommended text of an *Intermediate Accounting* module.
- Materials from other modules can be linked seamlessly into a web page—the *Computers in Accounting* module at California State University, Stanislaus⁴¹ has no recommended text, substituting a series of web-based *Readings*—links to

³⁵ To subscribe to *Accounting Education using Computers and Multimedia* (AECM-L): Send your subscription request to: mailserv@loyola.edu with the body of the message being: SUBSCRIBE AECM-L.

³⁶ <http://www.wbtsystems.com/>

³⁷ <http://cyber.ccsr.uiuc.edu/cyberprof/general/homepage/Newpage/toplevel/welcome.htm>

³⁸ <http://www.nwmissouri.edu/~0100541/businessfinance324.htm>

³⁹ <http://www.nbs.ntu.ac.uk/bai/>

⁴⁰ <http://www.people.memphis.edu/~dspice/articles.htm>

⁴¹ <http://panopticon.csustan.edu/syllabi/acc4160/acc4160.htm>

module material from other institutions and other externally produced materials, along with some internally produced web pages. Layout templates, including graphics, are readily copyable and customizable from any of the existing module web pages that can be found on the web.

CONCLUSION

Ives and Jarvenpaa (1996) suggest that the impetus for adoption of this technology must be driven from the top, from the institutional level. They suggest that business schools are vulnerable to takeover by nontraditional educational suppliers who embrace technology and that only those institutions with the strongest brand names are likely to survive. Many of the leaders are moving to ensure they do not lose ground. For example, the Sloan School of Management at MIT has developed a degree that uses the Internet to deliver course materials (Bradshaw 1996); Stanford University plans to introduce a paperless M.B.A.; and Harvard Business School redesigned its M.B.A. program to make full use of the technology (Griffith 1996).

As implied by Moore (1997), it may well be that only the brand leaders and the early adopters will ultimately survive. Yet, all institutions could develop along appropriate lines, ensuring their long-term ability to not be left behind by new entrants and existing competitors who are more willing to move with a rapidly changing educational environment.

From an accounting and finance perspective, many have already made the move toward embracing the potential of this new environment; and there are a number of excellent ex-

amples of the range of educational uses to which the World Wide Web can be put.

A widening in the geographical marketing and recruitment for courses, with its resultant need for more widespread use of this technology from remote students, places additional pressure on already limited institutional resources. The resource implications must be considered by both students and institutional funding managers if the technology is to be as widely adopted as some suggest. In addition, the development and use of these materials in an accounting syllabus is not always straightforward and is certainly not a costless activity for faculty.

As with any change to course delivery and materials, educators need to invest time in educating themselves about this new tool. Despite the large number of developmental resources available to accounting and finance faculty illustrated in this paper, the majority are not making use of them. The American Accounting Association and the European Accounting Association are responding to this through support for CPE courses and workshops at their annual meetings.

Anyone considering integrating web technology into courses needs to spend time on the web looking at resources and considering their potential application with their own students. The dynamic nature of the web will require a revisiting of this process frequently if the educator hopes to stay up-to-date with the latest resources. However, this is not a problem unique to accounting education. There are a number of methods and tools to help in this process ranging from web searching tools to

discussion groups, like AECM-L, populated by fellow educators attempting to address the same management and usage issues.

Evidence shows that students respond well to the change and may even perform more successfully in courses where such changes have taken place (Schutte 1997). This does not mean that technology can currently replace all acquisition of tacit knowledge through traditional means. There are undoubtedly many situations where traditional methods of delivery rather than web technology are appropriate. Web technology adds just one more multifaceted variable to the already infinite mix of teaching models available to the educator. Selection of the appropriate mix depends upon the nature of the materials to be handled and the skills

and experience of the educator managing the transfer.

Where the decision is made to explore integration of web technology, educators will find role models and expert advice easy to find. They will also discover that much of the initial work entailed in finding out what does and does not work has already been done. However, it is important that integrators of web technology remember that the web is only a resource—like anything else, it will only be helpful to adopt it if the adoption is undertaken in an appropriate way. Those contemplating integrating the technology into their modules or within their institution would be wise not to ignore the opportunities for learning from the experiences of others who have already trod this path.

REFERENCES

- Abraham E., C. Loughrey, and H. Whalen 1987. Computerised Practice Set in Introductory Financial Accounting. *Issues in Accounting Education* 2 (1): 1-12.
- Anderson, R. E., D. L. Klassen, T. Hansen, and D. Johnson. 1981. The affective and cognitive effects of microcomputer based science instruction. *Journal of Educational Technology Systems* 9 (4): 329-355.
- Anonymous. 1997. Virtual v-c for BAE. *The Times Higher Educational Supplement*. (May 23): 3.
- Borthick, A. F., and R. Clark 1987. Research on computing in accounting education: Opportunities and impediments. *Issue in Accounting Education* 2(2): 173-192.
- Bradshaw, D. 1996. The ticket to the future. *Financial Times*. September 30.
- Corrigan, D. 1996. The Internet University: Courses by Computer. Harwich, MA: Cape Software.
- Debreceeny, R., G. Smith, and C. White. 1996. Internet methodologies and the accounting curriculum: A first look. *Accounting Perspectives* 2 (1): 107-124.
- Dolence, M. G., and D. M. Norris. 1995. *Transforming Higher Education—A Vision for Learning in the 21st Century*. Ann Arbor, MI: The Society for College and University Planning.
- Drucker, P. 1997. Quoted in: Lenzner R. and S. S. Johnson, Seeing things as they really are. *Forbes*. (March 10).
- Fetter M., J. McKenzie, and D. Callaghan. 1986. Does the computer hinder accounting education? An analysis of some empirical data. *Issues in Accounting Education* 1(1): 76-85.

- Gordon D. 1962. Can accounting instruction be automated? *The Accounting Review* 37 (4): 692-695.
- Gray, M. 1996. Web growth summary. <<http://www.mit.edu/people/mkgray/net/web-growth-summary.html>>.
- Griffith, V. 1996. Chipping away at tradition. *Financial Times*. (December 9).
- Groome, S. 1981. An experiment in computer assisted instruction for introductory accounting. *The Accounting Review* 56 (4): 934-941.
- Helmi, M.A. 1986. Integrating the microcomputer into accounting education—Approaches and pitfalls. *Issues in Accounting Education* 1 (1): 102-111.
- Ives, B., and S. L. Jarvenpaa. 1996. Will the Internet revolutionize business education and research? *Sloan Management Review* (Spring): 33-41.
- Kachelmeier S., J. Jones, and J. Keller. 1992. Evaluating the effectiveness of a computer intensive learning aid for teaching pension accounting. *Issues in Accounting Education* 7 (2): 164-178.
- McInnes, W., D. Pyper, R. van der Meer, and R. Wilson. 1995. Computer aided learning in accounting: Educational and management perspectives. *Accounting Education, An International Journal* 4 (4): 319-334.
- Moore, T. E. 1997. The corporate university: transforming management education. *Accounting Horizons* 11(1): 77-85.
- Rada, R. 1996. Review of virtual organization seminar. <<http://134.121.242.55/gallup/admin/virorgrev.htm>>.
- Ruf, B., R. Brown, and H. Crawford. 1994. Computer assisted vs. traditional instruction: Differential moderating influences of math, verbal and visual-spatial abilities on learning. *British Accounting Review* 26 (2): 197-210.
- Sangster, A. 1992. Computer-based instruction in accounting education. *Accounting Education, An International Journal* 1(1): 13-32.
- Sangster, A., and C. Mulligan. 1997. Integrating the world wide web into an accounting systems course. *Accounting Education, An International Journal* 6 (1): 53-62.
- Schutte, J. G. 1997. Virtual teaching in higher education. <<http://www.csum.edu/sociology/virexp.htm>>.
- Scribner, E. 1990. A glimpse into an accounting department in the year 2000. *Issues in Accounting Education* 5 (1): 143-145.
- Skapinker, M. 1997. Management training takes to the runway. *Financial Times* (March 10): 19.
- Thomas, A. L. 1983. Use of microcomputer spreadsheet software in preparing and grading complex accounting problems. *The Accounting Review* (October): 777-786.
- Weick, K. E. 1985. Cosmos vs. chaos: Sense and nonsense in electronic contexts. *Organizational Dynamics* (Fall): 51-64.
- Weil, D. 1996a. Advantages and disadvantages of the web in the classroom: <<http://www.ithaca.edu/computing/cet/pilot/AdvDisAdv.html>>.
- . 1996b. Web in the classroom: survey results. <<http://www.ithaca.edu/computing/cet/pilot/SurveyResults.html>>.

9. Sangster, A. and Tyrrall, D. (2004), *Insights from internet-based research: Realising a qualitative understanding from a quantitative search process*, in 'The real life guide to accounting research', Humphrey, C. and Lee, B. (eds.), pp. 309-24. **[50%]**

Chapter 18

Insights from Internet-Based Research: Realising a Qualitative Understanding from a Quantitative Search Process

Alan Sangster and David E. Tyrrall

Introduction

This chapter relates the experiences of two researchers who conducted qualitative research using the *World Wide Web* (the web) as a main data source rather than following the more traditional fieldwork approach of gathering and analysing interview data. The aim is to illustrate the practical opportunities and the potential pitfalls inherent in such research.

The web came into existence in 1991 and developed from virtually nothing (130 websites in June 1993) to a position where, in January 1997, there were an estimated 650,000 websites (Gray 1996). By June 2001, this had risen to 8.4 million websites (Online Computer Library Corporation 2003). From a situation in 1997 where organisations were just beginning to recognise the Internet as a significant resource, it is now all-pervasive. Large organisations without a website are now very much in a minority (Fry *et al.* 2001).

Clearly, without the web, electronic commerce and the Amazon.coms of this world would not exist. This repackaging of traditional activities typifies the manner in which the existence of the web has changed the ways in which individuals view their work roles, private lives and interactions with other people and organisations. Information that previously would have either been impossible to obtain or, at the very least, difficult to find can now be obtained at the click of a mouse. Even at the simplest level, questions, such as, where can I get 'x', are now asked routinely through web search engines where previously they might have been considered virtually unanswerable.

At more sophisticated levels, researchers have grasped this opportunity to utilise the web to conduct literature searches, examine the way in which companies report their performance, analyse the availability of products and services, and even to access interim findings arising from the work of others in their field. For qualitative

**The Real Life Guide to Accounting Research: A Behind-the-Scenes View of Using Qualitative
Research Methods**

© 2004 Published by Elsevier Ltd.

ISBN: 0-08-043972-1

researchers, the web offers an apparently impersonal collection of artefacts (for examples, text, multimedia, streaming audio, streaming video, workstations, servers, software, web cameras) concerning business and interpersonal processes and interactions. These artefacts provide a rich source of previously non-existent insights capable of providing a different, and perhaps deeper, understanding of a wider range of phenomena than was previously possible. Further, the widespread availability and amount of data on the web has led to researchers asking new questions, developing new research ideas and theories, to reach a different and potentially richer understanding of phenomena than was possible in any given time frame even as recently as 10 years ago.

In this chapter, we report on two qualitative research projects in which the web played a central role, how our experiences helped inform our understanding of key issues relating to our chosen subject areas and enabled us to learn a number of important lessons on how to approach the web and web-based research. We argue that in web-based research, the generation of research ideas and collection of data are integrated and interdependent activities, perhaps even more than in other forms of research. Clearly, however, the difference in the two case study topics reported in this chapter — educational services and small breweries — gives only a small indication of the span in subject matter available on the web, which extends to all disciplines, industries, nations and demographic groups and beyond.

The first researcher, Alan Sangster, conducted research into web-based accounting education in 1997, when use of the web in education was still in its infancy. The second, David Tyrrall, researched the use of the web by small independent breweries some four years later, in 2001, by which time the World Wide Web had developed dramatically and its use by small and medium sized businesses appeared to have become relatively commonplace. In both cases, we adopted a perspectival approach to the research undertaken. That is, we both acted in the role of participative observers interacting with the object of research rather than as detached observers of independent phenomena.

We present the two projects below, not as they would traditionally be presented in an academic paper (introduction, hypotheses, analysis, conclusions), but rather as stylised and intertwined narratives. They are presented in this way, not to sanitise them (indeed rather the opposite), but to highlight lessons or 'morals' from our experience. Both researchers undertook their research as part of research teams to whom we are both very grateful,¹ but again for purely stylistic reasons we have recounted our research activities in the first person.

This chapter proceeds by first reviewing the motivation behind the studies. It explains how they started. It describes how the research process circulated through iterative stages of investigation, refinement, refocusing, back to investigation and so on. Lessons learnt concerning the conduct of web-based research are drawn at each stage. The outcomes from each study are discussed, and the research methods reviewed. Finally,

¹ Alan Sangster would like to acknowledge Christina Mulligan and Andy Lymer for their contributions to the work reported here and David Tyrrall would like to acknowledge and thank his co-researchers, Jackie Fry, G. Pugh and J. Wyld for their contributions.

the publishability of research of this kind is discussed in the context of the outputs from the studies.

Motivation

The Accounting Education Study

This study was motivated by a number of articles that forecast the start of a new educational era based upon the web. Its focus was an investigation of how the web was being used in education especially in relation to its use in accounting and finance education. On the basis of this literature and given that the web had developed from virtually nothing (130 websites in June 1993) to a position where, in January 1997, there were an estimated 650,000 websites (Gray 1996), it was felt likely that a number of pioneer academics would have already integrated the technology into their courses. The initial focus of the research was to find out whether there were simply a handful of web adopters or whether a vibrant community had already developed, and what early adopters were doing on their websites.

I did not come to this topic uninformed. I had been accessing the web since 1993, using it in courses since 1994, and had developed the first full-scale U.K. accounting department website. I had published research on the use of the web in education (Sangster 1995), on the use of the web in research (Sangster *et al.* 1997) and on the integration of the web into an accounting systems module (Sangster & Mulligan 1997). Hence, I felt well-equipped to empathise with the educators who were using the web in their teaching and to understand what I found. Both of these I felt to be prerequisites for being able to interpret what was observed.

The Small Breweries Study

At first sight this was not an obvious topic for me, as an accounting academic, to get involved in, so it is worth explaining what motivated the research. My colleagues and I had been approached by the pressure group CAMRA (Campaign for Real Ale) to analyse and develop an economic case for them to present to HM Treasury in support of tax concessions for small brewers. We concluded that since the distribution channels in the industry were dominated by the major breweries that they did have a case. We published a paper (Pugh *et al.* 2001) based on this work and eventually CAMRA won the concessions from HM Treasury in 2002.

The success of the first paper aroused our interest in the small brewery sector. We knew that difficulties in identifying the population are an acknowledged problem for small business research (Watson & Everett 1999; Nucci 1999) but, serendipitously, in looking at small breweries we had found a small business sector where it was possible to identify and survey the entire population (it is in CAMRA's annually updated *Good Beer Guide*).

During coffee table discussions we speculated on whether websites could provide small breweries with a means of circumventing the distribution channels dominated by the brewing majors. We also knew that it was U.K. government policy to make the U.K. the "best environment in the world for e-commerce" (Cabinet Office 1999: 1), with special emphasis on the development of e-commerce among small and medium sized enterprises (SMEs).

The initial idea was simply to survey how many small breweries had websites and what they had on the sites. We felt we could do the survey via the Internet. This approach could solve a number of problems that typically bedevil small business research. It would avoid the problem of traditionally low response rates to questionnaire surveys and the expense in terms of both time and money of a telephone survey. The issues and medium were topical; the population was available; it would be fun to do; and the work seemed comfortingly (to an accountant) quantitative.

Lessons:

- (1) Both of us had thought in advance about whether the research was likely to generate publishable results before we even got started. Putting it differently, was the outcome likely to pass the 'so what?' test? Although this moral is clearly applicable to all research, we feel it is easier to forget this when setting off on web based research. It is all too easy to dive into the web, seduced by the ease with which mounds of data can be accessed. Indeed to some extent, David fell into this trap. Alan clearly knew more about his topic than David did about his, but both knowledge and ignorance had their advantages and disadvantages as we shall see, especially since neither study turned out the way it had been expected to turn out.
- (2) More specifically, if you are interested in surveying a population or a sample of a population via the web, it is clearly useful to have some independent (in this case, non-web-based) way of enumerating it as a starting point. We both had such lists that did this; Alan, a list of universities, and David, a list of independent breweries.

Getting Started — A Toe in the Water

The Accounting Education Study

I was initially interested in how much accounting course material was available on the web. In a way, my initial question, like David's was a purely quantitative one — 'how many?' In one sense, such a web search in those days (1997) was not nearly as easy as it is now (2002). I was very familiar with the capabilities of search engines. In 1997 search engine algorithms were fairly crude — you could not simply type in the phrase, 'accounting courses' and expect a helpful result. My initial search using *Lycos* produced 2,173 URLs, and took 2 minutes (Sangster 1995). In just a few minutes of searching I found that, even with the more limited capabilities of the web and search engines at that

time compared to today, using search engines was going to result in information overload. Given that I was initially trying to find out how much there was out there on the web — the short answer was ‘too much’, or at least too much to look at in any reasonable time scale. As a result, I dropped the idea of using search engines to trawl the web for relevant sites.

Of course, the problem of overload is much greater now. To demonstrate how things have changed and are continuing to change, a search on ‘accounting courses’ using the *Google* search engine in April 2002 produced approximately 18,600 URLs in under 2 seconds. An identical search in October 2002 produced approximately 23,300 URLs in 0.36 seconds. A search in October 2002 for the word ‘accounting’ found approximately 9.64 million URLs in 0.22 seconds. Using *Lycos*, over 4.8 million URLs were found in less than 2 seconds.

The Small Breweries Study

Alan did not know in advance how much he was going to find. Our problem was somewhat different. At least we knew the maximum number of websites we had to find was around 450, if every independent brewery had one, which we felt was very unlikely.

We started trying to find the brewery websites by searching on key words or phrases using *AltaVista*, but soon found that millions of URLs were displayed — far too many to investigate other than on a blind sample basis. For example, the following key phrases generated the number of URLs shown:

- Beer 2,600,025
- Beer U.K. 12,207,184
- Breweries 14,201
- U.K. breweries 7,158,405
- Real ale 789,545
- U.K. real ale 12,510,780

The peculiar result that ‘beer U.K.’ generated more hits than ‘beer’ was due to *AltaVista* finding pages that had either ‘beer’ or ‘U.K.’ present. Evidently it was too big a haystack for too few needles. An important lesson was learnt at that point: use precise search strings so as to significantly reduce the number of hits generated. But, in this case, doing so still resulted in too many URLs being found. Nevertheless, this preliminary result gave us the germ of an idea.

Lessons:

These are obvious. The web is big and growing. If you have not limited your search area enough beforehand, you will find that there is too much to look at. If you have delimited your search area, you may still find that you cannot locate what you want. Either way, the comforting aspects are that:

- (1) this initial kind of search is easy to do; and
- (2) when it fails you will still have plenty of time to set about refining the search.

Refining the Search

The Accounting Education Study

I had to find some way to reduce the volume of material selected for investigation. After some consideration of what was available, I adopted three approaches:

- (1) I knew of a meta-site called *World Lecture Hall* (<http://www.utexas.edu/world/lecture>) which I had first heard about through an email discussion list. I had used it previously when directing students to worthwhile sources of alternative course material, and had submitted one of my own courses for inclusion in its database. The site was first launched in 1994 and by April 1997 it contained links to material from over 1,350 course modules, including 30 on accounting, 10 on finance, 25 on business administration, and 21 on management. Using that resource, I accessed the accounting and finance websites listed there and then drilled down looking for links they offered to other course websites.
- (2) I searched the *Yahoo!* database for anything relating to education and investigated the sites it listed for any evidence of accounting and finance course material. Using *Yahoo!* was a way of limiting the search because, I understood that site holders at that time had to register their sites with *Yahoo!* so only the websites of those with sufficient motivation to register them were listed. Also it was then, and is still now (searchenginewatch.com, August 2002) one of the most popular search engines, so anyone who really wanted people to find their accounting courses would place them on *Yahoo!*
- (3) I also searched all the existing U.K. university accounting and finance department websites (not all had websites at that time). Many of the department URLs were available on a metalist I had used previously. Others were accessed by drilling down from their university's home page to see if there was a website for an accounting and/or finance department.

Of these three strategies, the third proved both mind-numbingly tedious and very unsuccessful. There was very little course material at U.K. accounting and finance departments in 1997 but, having presented a number of conference papers about the use of the web, I had expected this result. Arguably this confirmation of the lack of adoption of the web among U.K. accounting and finance departments was, in itself, something worth reporting — but it was clearly insufficient to merit a full-length paper.

The *Yahoo!* searches were rather more successful. They yielded many educational web sites extolling the virtues of the use of the web in education and some excellent examples of how it could be done. However, I found very few accounting and finance department websites in *Yahoo!*, and even fewer with course materials. It seemed that

U.K. accounting and finance departments were no more or less dilatory in introducing websites than their colleagues elsewhere. It was another interesting finding but still insufficient for a paper.

In contrast, the *World Lecture Hall* was a success in providing accounting and finance course material URLs. However, these were a self-selecting sample of course materials since only sites that informed World Lecture Hall of their existence would be present on it. Quantifying what was out there was fading as an option.

The Small Breweries Study

The initial difficulties we had encountered in locating the websites gave us the idea of gauging the first time accessibility of the websites to potential customers. Accessibility is critical if product or company information is to influence customers' decisions (Thelwall 2000a, b). As accessibility is obviously going to be easier for someone skilled in how to find information on the web, we decided to look at the accessibility of brewery websites from the perspective of the individuals who would be most likely to want to visit them, many of whom would be relative novices in the use of the web. In short, we took an ethnographic approach. To that end, the search methods we adopted were those we expected most people interested in finding independent brewery websites to adopt. These were (Ernst & Young 2000; Thelwall 2000a):

- (i) typing in a known address,
- (ii) following a link from a search engine,
- (iii) using online shopping malls.

We started by using search engines, selecting *AltaVista* and *Yahoo!* because of their popularity (*Search Engine Watch* 2000), rather than because they were necessarily 'the best' search engines to use. But clearly, there was no guarantee that *AltaVista* and *Yahoo!* provided a complete listing of all independent breweries' URLs.

For those breweries the websites of which were not located using these sources, we typed in intuitive URLs (after Pirchegger & Wagenhofer 1999) for each brewery based on its name (as provided in the *Good Beer Guide*, CAMRA 2000) to see if a website existed. For example, Arkell's Brewery was entered as www.arkells.co.uk, www.arkellsbrewery.co.uk and www.arkells-brewery.co.uk.

We also tried looking at shopping malls, as our preliminary equivalent of Alan's meta-site. We swiftly found that, as we expected, they were useless. However, early on during our URL search we had found a number of very useful meta-sites with links to a large number (indeed a majority) of brewery websites.

We knew that simply finding out how many independent breweries had web sites would not suffice for a paper, so while locating, listing and book-marking the sites, we also recorded details of what facilities the breweries presented on, or how they used, their websites. Modes of use are typically presented as some form of progressive

adoption ladder (DTI 2000a), as stages in e-business development (Ernst & Young 2000) or as rankings (Cockburn & Wilson 1996; Thelwall 2000a). In fact, all methods display strong similarities. However, in order to take account of the specifics of the brewing industry, we had to make qualitative decisions on classification and scoring.

In effect, we were replicating Alan's strategy — but where he was using these approaches to focus his study downwards, we were using them to find what we had already decided to focus upon. For us therefore, it made sense to start gathering data very early on in our survey, something that Alan did not really get into until the next stage.

Lessons:

- (1) Researching on the web inevitably revolves around the use of multiple data collection strategies, such as the methods described above — typing in both known and intuitive addresses, use of search engines, and use of meta-sites. In addition, you could now use a domain name registration service such as *Simply Names* (<http://www.simply.com/>) to search all extensions of an intuitive name at once. However, this would only confirm the registration of a domain name. You would still have had to check whether or not a website actually existed. In addition, you would still fail to uncover websites with non-obvious names for their URL. For example, if you had looked for the (alas, no longer independent) Wolverhampton and Dudley brewery, you would have failed. They used the completely non-obvious www.fullpint.co.uk as their URL.
- (2) If you know (more or less) what you are looking for in web sites, it will save time if you start collecting such data as you find the sites. If you are less clear — don't bother — as the chances are high you will spend time collecting data you do not use. At this stage David was collecting (mostly) directly usable data, while Alan was collecting data (department URLs) the usefulness of which was not yet known in respect of the research question (they may or may not include links to course material). To some degree, you may simply have to resign yourself to collecting data that you do not use.
- (3) In either case, if you are using the web to collect survey-type data (as we both were), data collection will almost certainly have to be done reasonably quickly. If you miss any tricks during the data collection phase, you may not be able to simply retrace your steps and fill-in-the-blanks later. The web will have moved on, and you cannot backtrack the web to reinstate the earlier position. It is not the same as obtaining data through interviews — you cannot simply go back and interview the web a second time or seek clarification by telephone! This can mean that a wrong step or a misunderstanding of the robustness of the method or findings can lead to an entire study having to be repeated. Even more critically, flaws of this nature in web-based research may only come to light at the review stage of a paper, thereby making the entire paper and many months work relatively worthless.

Because of these three problems, you are likely to have to persevere through several stages of reconsidering the research project.

Reconsidering the Research Project

The Accounting Education Study

The main purpose of conducting this research was to show colleagues in accounting and finance what other accounting and finance academics were doing, in the hope that they would appreciate the benefits to both them and their students in embracing the technology. Change is much more likely to come about if there are obvious similarities in background between those being encouraged to change and those who have already changed. And, more directly to the point, research is far more likely to be published if editors can see the relevance to the discipline of the work being reported.

Given that overall quantification of relevant websites had proved impossible, how could the research study be refocused in order to produce something worthwhile? I considered focusing on the use of the web in education in general and using the *Yahoo!* registered sites. However, that would have meant changing the focus of the research so much that, while the results would undoubtedly have been of interest to an accounting and finance audience, they would not have been directly applicable to the discipline, and so might not have been acceptable to the editors of the leading accounting and finance journals. I had to maintain an accounting and finance focus if I were to stand a realistic chance of having the research findings published in my target journal.

I decided I had sufficient data to demonstrate the range of accounting and finance course material being offered on websites, but that I needed to ensure that: (a) I did not understate what was available; and (b) the picture I presented of what was being presented was not demonstrably skewed as a result of omitting additional and easy to obtain data.

I decided to re-examine the nature of the websites I had found and spent a couple of days looking at them gaining a picture of the sort of information they contained. It became clear that some of those placing their course material on the web had extensive links from their web pages to other people's course material. This seemed to be a way in which to avoid missing very many relevant websites. As a result, I decided to investigate the websites of the most web-aware accounting and finance academics (as defined by the inclusion of their course material at the *World Lecture Hall*) and use them as the main source for finding other relevant websites.

Any websites found in this way would, by definition, be accounting and finance focused, fulfilling the original aim of the research. However, by doing so, I acknowledged that only a self-selecting sample would result, potentially limiting the generalisability of the findings. However, that did not prevent the findings being generalised across the websites that had been found. David had to be able to generalise across his population of small breweries, but for me being able to generalise across a

population was not necessarily relevant. What was relevant was that I could demonstrate that the findings were relevant to: (a) the source of those findings (the accounting and finance websites that had been identified); and (b) demonstrably of interest to a wider community (accounting and finance academics).

Bearing in mind the need for speed, spending 12–15 hours a day over each of the next seven days, 86 potentially relevant course URLs (30 accounting, 10 finance, 25 business administration, and 21 management) were examined and those with accounting and finance material were bookmarked. In each case, the relevant department website was also examined to see if any other accounting and finance modules had made course material available on the web.

From this point, I switched to looking in detail at the material in each site to see if there were any links to other course materials provided elsewhere. It was during this phase that I found a meta-site of accounting course material as one of the resources on offer at a course website. The meta-site was called 'Accounting Academia' (<http://www.taxsites.com/academia.html>). It listed 65 accounting module websites and led to another site maintained by the same person that listed 43 tax module websites. Then, while continuing my survey of finance course URLs, I found yet another meta-site 'Finance Courses on the Web' (http://fisher.osu.edu/fin/resources_education/edcourse.htm) that held 128 module URLs. Just as David had found, these much more specific meta-sites proved to be the turning point in the research.

Again, it was time to redefine the research. At the last revision, I felt that it would be too difficult to find a good cross-section of websites and a switch in focus had been made towards looking mainly at the ones recorded at the *World Lecture Hall*. Now, everything had changed and many more websites were available than had been expected — too many, in fact, to enable the content of them all to be analysed. I decided to focus on the 65 accounting modules linked from *Accounting Academia*.

Lessons:

- (1) Alan's problem had been finding some way of narrowing focus. David's problem had been finding an unknown quantity (but not more than 450!) of needles in a haystack. In both cases meta-sites had been very significant, indeed essential to success. A key technique in refining, and hence expediting, any search is to locate any meta-sites that deal with the field of interest. It is highly likely that someone (public-spirited) has been there before you.
- (2) Methodologically however, it will be necessary to consider if it matters whether you can locate the population you seek or whether useful results may be obtained from the sample you happen to uncover. Putting it differently, the critical aspect is to decide what it is you are seeking and be able to justify the search method selected, while being aware that
- (3) What you seek is likely to be conditioned by what you can find. However, at least you are well down the pathway of funnel and focus.

Funnel and Focus

The Small Breweries Study

We had never ruled out quantification — indeed it was our goal, and we seemed to be almost there. We circulated our brewery URL listings on an informal basis to the people running meta-sites, and they confirmed that, so far as they were aware, our list was complete. The URL identification procedure we used may have omitted some breweries, but it is likely that only a small minority of the population of independent brewery websites were missing by the time we had compiled our list. Indeed, our own view was, and still is, that we found the lot — but academic caveats do not permit such bold assertions, so we settled on the formulation in the previous sentence for our journal submission! At the same time, we had also collected a lot of data on the facilities present on the web sites. The problem now was what to do with all this data. We were down the funnel, but what was the focus? Putting it differently, what question, if any, did we have the answer to?

The Accounting Education Study

In contrast, I already had a focus. Adopting an ethnographic approach, I was investigating what was happening on all these 65 websites, reflecting on what I found through the lens of my own experiences in doing the same thing. But this meant I had not really started down the funnel of collecting data, something that David had almost completed by this stage.

I started by creating an initial list of features to look for in course websites. As the basis for this list, I used the range of things I had established at my own course website — notes, spreadsheets, links to other resources, past exam papers, assignments, email contact to faculty, electronic class discussion list, timetable, course glossary. As I visited the first few websites, other features were added to the list, including additional notes, objective tests, class lists, and password protected access. Each time a new feature was added, previously visited websites were swiftly revisited and reclassified where appropriate.

After I had examined 20 or so sites I realised that some of these features needed to be split, so lecture notes were split into ASCII text, word-processed documents, adobe acrobat files, and PowerPoint notes. Further refinements were made to the list as more sites were visited, including overhead transparency availability and the availability of soundbites. Again, each time a feature was split, such as occurred with overhead transparencies (when the feature was split into word-processed, HTML, and PowerPoint) each of the sites where the original feature had been found was revisited and reclassified. The process of observing the content of the sixty-five websites took two weeks, working twelve to fifteen hours a day every day. Ironically, both Sundays — the best day at that time to do this type of work — were lost due to the transatlantic line into the Janet network going down — something so rare nowadays that it would seldom matter but, in 1996, this was not an infrequent occurrence.

During the following six weeks, the sites were all revisited to see if there had been any significant changes. A behaviour change across the sites was apparent, even in such a short period. One site moved from free access to student work and grades to password protected access, some of the sites that provided resource links updated their lists, one did so dynamically every time something of interest was found by the lecturer. Some added overhead transparencies and lectures as each week passed. Others removed material as its relevance passed. Those that included discussion lists and FAQs changed frequently.

It was a very dynamic and changing environment and, at that time, it did look as if free access was likely to grow although restricted access to some materials, even then, was beginning to become noticeable. None of the sites charged for materials. However, in the course of the research a link was found to a website offering a pay-for-use on-line CPE-credit-bearing auditing course.

In two cases, I attempted on-line sample objective tests. In another site I tried an early attempt at a graphical demo that involved entering data and then seeing the effect on a graph. I could have sent messages to some of the discussion lists, but did not. However, I did review and monitor the communication in the discussion lists over the six-week monitoring period. While this was undoubtedly participative observation (as I was doing what many of the student users were doing in accessing the course material) at no time did I let any of the academics whose courses I was monitoring know I was doing this and they will all have been totally unaware of my having been observing them.

Lessons:

Both studies encountered a theory issue. The tentative theories with which we both started were used as springboards to get started. After that the nature of the data we uncovered began to dictate a research approach. Participative observation was adopted in Alan's case. In David's, there was no benefit to the research in doing so. The key is to be open to the opportunities presented and to adjust research method accordingly, but that leads to a problem in theorising the results.

Theorising the Results

The Small Breweries Study

Our initial hypothesis that independent breweries might use the Internet as a means of bypassing the distribution channels dominated by the major breweries was clearly wrong. Indeed, we formed the view that the majority of brewery websites were not very accessible to anyone looking for them, and on reflection, realised that this was our most striking finding. In other words, the breweries had created low visibility web-sites. Why would they do this? Or, putting it differently, what had we discovered?

We explored the possibility of relating our results to the major models of business decision-making, the rational or classical model (Ansoff 1965), the emergent model (Mintzberg 1987) and even the garbage can model (Cohen *et al.* 1972), but our existing work did not enable us to make more than preliminary judgements. It would require extensive and careful interview and survey-based research to uncover the issues.

We had already looked at other surveys (for example, DTI 2000a), and were getting very similar results for the proportion of micro-businesses with websites, despite having markedly different research strategies. This meant we were not barking up the wrong tree — but that we still needed a way of presenting our major result. We knew that attempts had been made in the literature to measure the accessibility of web sites — but none that balanced the results of a range of search techniques. So we decided to devise one ourselves.

Each website was awarded points according to various aspects of its accessibility: links to the brewery meta-sites, appearing in the 'top 20 hits' of an *AltaVista* search, having a *Yahoo!* directory listing and having a URL that we rated as 'easy' to guess. From this we were able to generate a frequency distribution showing that the breweries scored badly on our accessibility rating. This was in line with our expectations and other research (Thelwall 2000a), but we were troubled by this result because it gave a heavy weighting to a presence on the meta-sites. We experimented with two different weighting systems to overcome this. Both reduced the effective weightings on meta-sites. In one case the heavy weightings were transferred to registrations with search engines. Predictably, this made the breweries' accessibilities appear even worse. The other weighting placed more emphasis on an easy URL, which equally predictably improved all the ratings. In the end, we decided that it would be best to stick with the simple accessibility rating. Of course this had the curious result that an overtly quantitative frequency distribution was actually underpinned by a series of qualitative decisions.

It is still a bit too early to judge how much of a success or failure this project was. At the theoretical level, we had found an anomalous result in need of a theoretical explanation — a limited contribution (at best). But arguably that had never been our intention. Instead, we wrote it up into a paper that focused on the business and policy implications of our findings. We had found a lower uptake of the higher steps on the adoption ladder among small breweries than the DTI (2000a) had found among its sample of small businesses in general. Indeed most were still at level zero (no website). Furthermore, it appeared likely that many of those with web sites could enhance their web site usage by a variety of comparatively simple and non-technical steps. Yet U.K. government advice on business use of the Internet tends to focus on the technical aspects of the Internet rather than on the business aspects (DTI 2000b). Hence the appropriateness of the advice on offer was probably meaningless to all but a minority of the independent breweries, and by extension, to many small businesses. Our paper was considered of sufficient merit to be accepted for a respectable refereed conference, and it appeared in the proceedings (Fry *et al.* 2001). It has now been accepted by a leading journal after taking referees' suggestions to focus even more closely on the business and policy aspects.

The Accounting Education Study

By the end of this period of participative observation, I had built up a picture of how the web was being used in accounting education and had formed a view concerning trends in availability and in restriction of access. A number of case studies on the use of the web in education had been found. Reference back to the educational material found near the start of the research found evidence to support the view that the trends in web usage noticed in respect of accounting courses were also happening in university education in general.

The entire research exercise took about three months. It generated a number of case studies describing innovative ways people were using the web in accounting and finance education from various institutions around the world. In particular, it was able to present views on educational use of the technology, pointers to a range of web-related developments, and indications of the wealth of support available on the *Internet* for integrating *World Wide Web* into the curriculum. Despite its ethnographic, non-positivist focus, it resulted in three refereed conference papers, a seminar paper, and a paper published (Sangster & Lymer 1998) in the American Accounting Association journal, *Issues in Accounting Education*.

Lessons:

We both encountered problems in developing theoretical implications of our findings, which we resolved in different ways.

- (1) Alan did not attempt to find an explanation for what was found, but he did develop a model to classify and characterise the websites identified. Once he had developed the model and completed his classification, he then utilised the strengths of the vehicle of investigation (the web browser) to play the role of a participant observer in order to identify trends in behaviour and provision that appeared to be emerging. Despite the adoption of a qualitative approach to the research, the research resulted in findings that were of sufficient interest to be published in a leading accounting journal.
- (2) David found some surprising evidence that indicated that independent breweries did not appear to be using their websites in a manner that would make them commercially worthwhile developing, but found it impossible to explain what had been found. Another project would be needed to find such explanations — but that is the most commonly observed result of any research! On the other hand it did generate practical business and policy implications relevant to small business — which was the original intent.

Conclusion

In this chapter, we have reported on two studies conducted four years apart, both of which focused on the existence of information on the web. The first investigated the availability of accounting course materials on the web and the second investigated

the existence of independent brewery websites and their accessibility to real ale enthusiasts.

One major issue confronted in both studies was that the web is in a constant state of flux. Organisations and individuals remain a long way from deciding how best to use the medium. What is here today may be gone tomorrow (Katz 2000). As a result, academic theory and research practice have lagged behind developments in the adoption of web technology. This means that there is either a pressing need for research that can capture and explain rapidly changing phenomena, or that we may be attempting to deal with ephemera. Observation studies, such as the one carried out by Alan once he had identified where to look, may be the key to identifying trends in this area. Indeed, David, in reworking his paper to meet the referees' recommendations, took the opportunity to revisit the web sites as a form of observation study. However, for web-based research more generally, there remain the problems inherent in actually identifying where to look in the first place.

Consequently, it is in the nature of web-focused research that the primary need was, and still is to find out what is being done before attempting to explain it. Essentially our approaches were, as in Poon & Swatman (1999: 10) 'exploratory' and we did not commence 'with any specific set of hypotheses'. Any research conducted that focuses on the web as the object of research needs to be flexible and reactive to change. While a tentative hypothesis existed at the start of each of our studies, in reality, they both progressed through the development and continual refining of research questions.

More prosaically, we learned some practical lessons about web-based research, in addition to those already mentioned earlier. In David's case, he dived into this one blind. He knew comparatively little about company websites or web technology. Rather he was seduced by the possibilities of surveying a population rather than a sample, and of building on his previous work. In David's case, it might have been a good idea to get someone with specific knowledge of our areas of ignorance into the team. On the other hand, having a defined population also defined the research target — the methods changed and so, therefore, did the result but the target was fixed all along. But if David had known more, he might never have done it, which would have been a pity, because there is clearly an opportunity for more research in this field. Alan was much more informed before he started out but even he was surprised by the amount of material out there and had to change his research target and focus as he learned more.

Despite neither project adopting a positivist perspective, both proved of interest to the research community. In doing so, they demonstrate that web-focused qualitative research is both a viable and challenging activity and one that lends itself more to grounded theory and participative observation than might naturally be assumed to be the case. We would both recommend it as a research mode - and we will both do it again!

References

- Ansoff, I. (1965). *Corporate strategy*. U.K.: McGraw-Hill.
Cabinet Office (1999). E-commerce@its.best.uk. Performance and Innovation Unit Report. <http://www.cabinet-office.gov.uk/innovation/1999/ecommerce/index.htm>.

- CAMRA (1999). *The Good Beer Guide 2000*. St. Albans: CAMRA.
- CAMRA (2000). *The Good Beer Guide 2001*. St. Albans: CAMRA.
- Cockburn, C., & Wilson, T. (1996). Business use of the world wide web. *International Journal of Information Management*, 16(2), 83–102.
- Cohen, M., March, J., & Olsen, J. (1972). A garbage can model of organizational choice. *Administrative Science Quarterly*, 17(1), 1–25.
- DTI (2000a). *Business in the information age: International benchmarking study 2000*. <http://www.ukonlineforbusiness.gov.uk/>
- DTI (2000b). *E-commerce: How trading on-line can work for you*. <http://www.ukonlineforbusiness.gov.uk/>
- Ernst and Young (2000). *Global online retailing*, (Ernst and Young Special Report), EandY. http://www.ey.com/global/gcr.nsf/international/global_online_retailing_-_RCP.
- Fry, J., Pugh, G. T., Tyrrall, D., & Wyld, J. (2001). The use of the world wide web by U.K. independent breweries: global reach or global invisibility? Proceedings of the International Academy of Business Conference, April 6–7, Manchester, U.K.
- Gray, M. (1996). *Web growth summary*, <http://www.mit.edu/people/mkgray/net/web-growth-summary.html>.
- Katz, J. (2000). This changes everything? Implications of e-commerce for entrepreneurship research. Keynote address to the 2000 Small Business and Enterprise Development Conference, April 10th–11th, University of Manchester, Manchester, England.
- Mintzberg, H. (1987). Crafting strategy. *Harvard Business Review*, July–August, 65–75.
- Nucci, A. (1999). The demography of business closings. *Small Business Economics*, 12(1), 25–39.
- Online Computer Library Corporation (2003). <http://wcp.oclc.org/>
- Pirchegger, B., & Wagenhofer, A. (1999). Financial information on the internet. *European Accounting Review*, 8(2), 383–395.
- Poon, S., & Swatman, P. (1999). An exploratory study of small business internet commerce issues. *Information and Management*, 35(1), 9–18.
- Pugh, G. T., Tyrrall, D., & Wyld, J. (2001). Will progressive beer duty really help U.K. small breweries? A case study in profit appropriation. *Journal of Small Business and Enterprise Development*, 8(4), 311–337.
- Sangster, A. (1995). World wide web — what can it do for education? *Active Learning*, 1(2, July), 3–8.
- Sangster, A., & Mulligan, C. (1997). Integrating the world wide web into an accounting systems course. *Accounting Education: An International Journal*, 6(1), 53–62.
- Sangster, A., & Lymer, A. M. (1998). How to survive a new educational era. *Issues in Accounting Education (AAA)*, 13(4), 1095–1109.
- Sangster, A., Baldwin, A., & Lymer, A. M. (1997). Using the world wide web in accounting research: A huge step forward or a new constraint? *British Accounting Review*, 29(4), 395–407.
- Search Engine Watch (2000). The major search engines. http://searchenginewatch.com/links/Major_Search_Engines/The_Major_Search_Engines/index.html Accessed September 2000 and August 2002.
- Thelwall, M. (2000a). Effective websites for small and medium-sized enterprises. *Journal of Small Business and Enterprise Development*, 7(2), 149–159.
- Thelwall, M. (2000b). Commercial websites: lost in cyberspace? *Internet Research: Electronic Networking Applications and Policy*, 10(2), 150–159.
- Watson, T., & Everett, J. (1999). Small business failure rates. *International Small Business Journal*, 17(2), 31–45.

10. Aisbitt, S.A. and Sangster, A. (2005), *Using Internet-based On-line Assessment: A Case Study*, *Accounting Education*, an international journal, Vol. 14, No. 4, pp. 383–94. [50%]

Using Internet-based On-line Assessment: A Case Study

SALLY AISBITT* & ALAN SANGSTER**

*The Open University Business School, UK, **The Robert Gordon University, UK

(Received November 2004; revised May 2005; accepted July 2005)

ABSTRACT *This paper describes the background, design process, and implementation problems encountered during the first year of use of an asynchronous internet-based on-line assessment system on an introductory accounting course. The on-line assessment system was both summative and formative in nature and was designed to encourage and reinforce the learning of basic principles. The paper reports a positive correlation between student performance in the on-line assessments and in their final examination. It concludes with a list of issues to be considered when embarking on a venture of this sort.*

KEY WORDS: Internet-based online assessment, accounting, evaluation

Introduction

In 1999, the UK Government announced that by 2010/11 at least 50% of 18 to 30-year-olds would have experience of higher (i.e. undergraduate level) education. This was to happen without any fall in standards. The participation rate in 1999/2000 was between 35 and 40%.

While universities and the Government are working together on ways to raise the level of student participation, one change in teaching and learning that is already occurring will help universities move closer to achieving the Government's target—the widespread adoption of technology in teaching and learning. The adoption of e-learning has gained momentum to a point where it will not be long before education and assessment using electronic media is as normal as face-to-face delivery.

While, in theory, there are indisputable emancipatory benefits to be gained in the adoption of e-learning, e.g. 24/7 delivery, increased flexibility in the learning process—there is a lack of research evidence to provide guidance on how best to integrate technology in the curriculum (e.g. Rebele *et al.*, 1998). Furthermore, there is very little evidence that technology can be used successfully to deliver another potentially liberating element of e-learning, internet-based on-line assessment (OLA). Yet some departments are moving towards its adoption as a component of their e-learning strategies.

Correspondence Address: Dr Sally A. Aisbitt, The Open University Business School, Walton Hall, Milton Keynes MK7 6AA, UK. E-mail: s.a.aisbitt@open.ac.uk

This paper seeks to redress this situation by providing guidance on issues to be considered when integrating internet-based on-line assessment. It does so by reporting a case study describing integration of the technology into a UK university third level 60-credit accounting course¹—*The Certificate in Accounting*.

The university where this took place (The Open University) has more than 200 000 students. The courses at the university are taught through distributed learning (combining texts, multi-media and interactive on-line study) supported by a combination of electronic asynchronous tutor and peer group support and occasional face-to-face tuition.

Virtually all students at the university are part-time and are expected to study for 12 hours each week. The inherent flexibility of the university's teaching methods allows students to change jobs (and even country) without disrupting their studies.

As is the case with most of the university's courses, the *Certificate in Accounting* is available, not just in the UK and Ireland, but throughout most of Europe.

The rest of this paper presents background on the *Certificate in Accounting* and an overview of the design of the course, focusing upon the development and subsequent integration of objective test-based on-line assessment delivered over the Internet. Problems that arose during development of the OLA and during the first year of its operation are also discussed. Finally, the effectiveness of the OLA strategy is considered and recommendations are offered for anyone considering integration of on-line assessment within their courses.

The Certificate in Accounting

The *Certificate in Accounting* is a unique accounting course in higher education in the UK in that (a) there are no minimum entry requirements and (b) certificands are eligible for exemptions from at least the first level examinations of major UK (and international) accountancy bodies, notably the Association of Chartered Certified Accountants (ACCA), the Chartered Institute of Management Accountants (CIMA) and the Chartered Institute of Public Finance and Accountancy (CIPFA).

The first cohort of students completed the course in October 2002 at the end of a 12-month period of part-time supported open learning.²

Design of the Course

Integration of Information and Computer Technology (ICT)

ICT is integrated throughout every facet of the course in a *financially* cost-effective manner to present foundation level accounting in an attractive way, so motivating students to continue their study towards a professional career. At no point is ICT integrated for ICT's sake.

Validity for the extent of integration is to be found in both the accounting and the education literature. In UK universities, accounting is studied as a 'major', as a first step towards a career in accounting. Accounting graduates generally go on to study for the examinations of one of the accountancy bodies. It has long been held in the USA (e.g. AAA, 1970) and in the UK (e.g. Sangster, 1992) that accounting departments owe it to their students to provide what they need for both their current studies and their future careers, and that includes ICT integrated in their courses, rather than included as an 'added extra'.

In 2000, Albrecht and Sack identified the importance of structuring accounting programmes to ensure they are attractive to students *and* their potential employers in terms

of their pedagogy and learning outcomes. In their study, both faculty and practitioners identified technology skills that *should not be ignored* in accounting curricula. Accounting students must not only be exposed to technology during their studies, but any such exposure should be in a meaningful and appropriately integrated manner.

Beyond the accounting discipline, champions of the use of ICT in education make great claims for what it can do to improve the student experience. IBM and Cisco, for example, say that 'technology has the potential to transform and extend the way universities operate—impacting teaching, learning, research and administration—making them more efficient, effective and innovative' (*The Times Higher Education Supplement*, 7 February 2003, p. X).

The *Certificate in Accounting's* teaching, learning and assessment strategy follows the advice of Albrecht and Sack (2000) and accords with Bryant and Hunton's (2000) use of technology guidelines for accounting educators. The main uses of ICT in the course are:

- Thirty hours of study during a five-week pre-course electronic induction period using instructional and formative assessment material on CD, internet-based on-line formative assessment, and asynchronous electronic conferencing in one cohort group (500 in 2001/2) mediated by two academics.
- Full integration of various instructional media (computer-based learning CDs, web-based material, electronic conferencing and text) in course materials used throughout the year of study.
- Use of on-line assessment, both formative and summative, at regular intervals throughout the course.

The rest of this paper focuses upon OLA.

Integration of the On-line Assessment

Formative or Summative?

It is essential that accounting students are competent in basic concepts before they progress to issues that are more complex. Regular formative diagnosis of the extent of their learning and understanding may help students raise their level of competence. One way of providing this diagnostic tool is through short question tests. These are more likely to be effective if composed of objective test questions where some answers have to be entered by the students rather than simply selected from a range of alternatives, as in tests composed solely of multiple-choice questions.

Whether *formative* testing actually improves final grades is unproven—research comparing the results of formative objective tests with final essay type examinations has had mixed results (e.g. Sangster and Wilson, 1991; Murphy and Stanga, 1994; Sangster, 1996). This is hardly surprising when, by definition, formative tests *do not* contribute to final course grades and experience suggests that it will often be the students who most need to know what they do not know or understand who will avoid any testing that 'does not count'. One way of ensuring that students take these exercises seriously is to ensure that they *do* count towards the final grade.

It was felt essential that students should be alerted to their weaknesses in knowledge and understanding. Accordingly, it was decided to integrate regular objective tests that were both formative *and* summative in nature into the course.

The Decision to Use OLA for Delivery of the Objective Tests

As computerized tests can be administered quickly with instantaneous feedback, allowing students to take appropriate remedial action before continuing with the course (Sangster, 1996); and faculty also benefit through a reduction in their marking and administrative burdens, the decision was taken to computerise the objective tests.

The computerized objective tests could have been distributed on CD or floppy disc or made available for download from a website; but all of these options transferred control over the assessment process from faculty to students. An alternative was on-line assessment.

OLA has also been identified as an important way to increase teacher effectiveness (e.g. Boyce, 1999). Faculty experience an increase in control—they know who did what, and when.

It was felt by the course development team, that if OLA was adopted, even if the students themselves did not take advantage of the formative feedback from the tests, so long as the underlying OLA infrastructure was integrated into the university's assignment marking system, the tutors would receive consistent and timely information concerning the aspects of the course subject content that were proving difficult for their assigned group of students.

On the basis of this analysis of the research evidence, and in line with other courses at the university, it was decided to use OLA as a component of assessment in the course. It remained to select the OLA software.

Software Selection

After extensive evaluation of available software, *QuestionMark Perception* was chosen as:

- earlier versions had been used by the leader of the course team;
- it offered a wide range of question types, including multiple choice, multiple response, numeric, and text entry;
- graphic images could be included in questions;
- it was the market leading software of this type in the UK;
- it appeared to be capable of providing the flexibility in question design and feedback that the course team required;
- the vendors stated that other institutions had used it for on-line assessment and that it could cope with the maximum number of students (1000) envisaged by the course team;
- it included the facility to specify when a test was to be made available to students, how long was allowed to complete it, and when it was to cease to be available; and
- it was felt prudent to use a well-proven product with its own well-respected user-support team.

The Summative OLA

Six hundred objective test questions were prepared for the summative OLA, organized into 100-question tests scheduled approximately six weeks apart. These tests were called 'Computer-marked Tutor-Moderated Assessments' (CTMAs). They accounted for one-third of the overall marks on the course and students were only eligible to pass the course if they achieved an average of 40% across the six CTMAs and three Tutor Marked Assignments (TMAs).³

The CTMA questions were delivered from a secure specific-to-the-individual password-protected server in real time. Students had a two-week window in which to undertake each of these assessments and typically spent around three hours on each of them.

Students received their mark immediately after they finished each CTMA, but they were not given any indication of *which* questions they had answered correctly at this stage. The day after the CTMA window closed, all the students' answers were transferred to the university's electronic Tutor Marked Assignment (eTMA) system and their marks entered in the university's central student marks database.

Within 48 hours of the CTMA deadline, the course team produced an analysis of the students' performance and sent it electronically to all the tutors, showing descriptive statistics, such as the distribution of marks and the time spent on the exercise. Tutors then combined this information with the information on each student held on the eTMA system. As a result, they could identify how well their students performed compared with the rest of their tutor group and with the overall cohort.

The tutors then completed a report for each student containing additional feedback and attached it electronically to the student's CTMA data on the eTMA database. Students could then access the eTMA system and collected their tutor's comments along with a *QuestionMark*-generated HTML report showing each question, what their answer was, whether the answer was correct, the correct answer, and additional feedback that varied according to the answer given by the student.

In addition, tutors could use the knowledge they gained to offer remedial teaching on areas that had proved problematic, both through their tutor group on-line conferences and in face-to-face workshops. (Time was formally allocated for this in each workshop.)

The Formative OLA

Apart from the formative aspects of the summative CTMAs, two other sets of purely formative CTMAs were made available. A further 600 objective test questions were prepared for six 'practice CTMAs', the first of which was made available two weeks before the first two-week CTMA window. It covered the same topics as the impending summative CTMA. Students received feedback after every 10 questions, and they could attempt the practice CTMA as often as they wished. The same was done before each of the other five summative CTMAs.

In addition, as students had coursework and examinations on the same material later in the course, two days after the window closed for each summative CTMA, it was re-released as an additional formative CTMA, with answers and feedback. As with the practice CTMAs, students could work through these purely formative versions of the summative CTMAs as many times as they wished.

Introducing Students to the OLA Software and to the Nature of the CTMAs

There was a risk that students would attempt the first CTMA without previously using *QuestionMark Perception*. While the first practice CTMA was expected to reduce this risk, it was assumed that a significant number of the students would not take advantage of the practice CTMA because it was purely formative.

To address this, students were given the opportunity to familiarise themselves with *QuestionMark Perception* during the pre-course five-week induction period. This was done by giving them an on-line questionnaire at the start of the five weeks on their background and their aims and objectives in doing the course plus a 20-question test on double entry bookkeeping at the end of the five weeks.

Problems Encountered Writing the OLA Questions

A number of problems were encountered relating to the integration of OLA concerning writing questions and operating the OLA system. These problems could all have been avoided with appropriate planning. They are all issues that anyone embarking on writing effective objective test questions for use in OLA must be prepared to face.

Feedback in the OLAs

Including sufficiently comprehensive feedback for these, supported open learning students increased the time spent writing questions to an average of one hour per question. The original estimate was 5–10 minutes. As 1800 questions were written for the course (600 of which were for use with the second cohort), this turned an anticipated seven-week task into one that actually took over 10 months.

Errors in the OLAs

An average of 3–4% of the questions contained errors or ambiguities when they were first used with the students, despite what appeared to be a foolproof checking process: the 1800 questions were devised by six academics, one of whom then entered them into *QuestionMark Perception*. The questions were then tested by a team of five academics and one editor, all of whom considered the suitability of the questions (including answers and feedback) from the perspectives of consistency with course material, accuracy, and grammar.

Using the Appropriate Question Type

The 'numeric' question type provided in *QuestionMark Perception* proved unusable as it allowed students to enter words instead of numbers but always marked them as being incorrect; and it could not cope with answers of '0'. All questions written using this question type had to be rewritten as 'text entry' questions, which correctly recognised both numbers and text.

Marks per Question

All questions had to be given one mark, even where they were 'multiple response' questions or 'matching pair' questions that could have many sub-questions within them.

Use of Tables Versus Calculator Versus Spreadsheet for Discounted Cash Flow Questions

Students could use any of these three sources to arrive at discount rates but could only submit their answers, not their workings. Unfortunately, this could result in three different answers being correct—even more if the number of decimal places being used is taken into account. Initially, multiple 'correct' answers were coded into the questions and the feedback explained what other answers were possible. This was subsequently simplified by instructing students always to use the tables provided in their course materials.

Roundings and Units to Use in the Answers

Given the relative inflexibility of the marking engine, clear instructions had to be given *in each question* indicating the number of decimal places to enter. Instructions were given in

each computational question of the units in which answers should be expressed, e.g. pounds or pence; grammes or kilogrammes; centimetres or metres.

Spelling

Text entry answers are marked by comparing the string of text entered to the correct answer. If there is any difference in the spelling (e.g. 'break-even' when 'breakeven' is 'correct') the answer is 'wrong'. Multiple spelling variants were embedded into the questions as 'correct' answers, but they could not guarantee to capture all correct answers and, if not chosen carefully, wrong answers could be marked correct. For example, to cope with spelling errors when the correct answer is 'depreciation', the 'correct' answer may be coded as a string including 'dep', which means that an answer of 'depletion' would be marked 'correct'.

Authorship

It was discovered that only accounting faculty could author and put valid questions into the software in a way that made sense. Non-specialists were unaware of the difference between technical terms and everyday language and had no idea of the techniques to test, never mind how to do so.

Problems Encountered During the OLAs

The problems discussed in this section created an enormous burden for faculty running the course, a burden involving working weekends and late into the night, at times up to 19 hours a day. As with the problems relating to writing the questions, anyone considering use of objective tests in OLA ought to ensure the problems discussed in this section will not arise before the system goes live.

Students' Problems

Spelling. Whereas this has little impact upon students when a human marker is involved, some students—particularly those for whom English was not their first language—perceived great wrongs had been committed against them in the CTMAs, even though spelling errors contributed, at most, to the loss of only one or two marks out of 100 in any student's CTMA. However, even the most belligerent students accepted that the benefits to be gained (speed of marking and receipt of feedback), if they accepted responsibility for their own spelling errors, made the cost worthwhile.

Errors by the students when they accessed the CTMAs caused further problems.

Opening more than one copy of the CTMA simultaneously. This occurred if students double-clicked (instead of single-clicked) when they selected the CTMA. If they later needed to restart, they were often taken to the second copy of the CTMA instead of the one on which they had been working. This resulted in such students completing part of the CTMA in one instance and completing the entire CTMA in the other.

The multiple reports generated were combined manually and the costs in terms of staff time and student goodwill were significant.

Firewalls. Some students did not own a PC but used one at work or in a public library. In a small number of cases, their work network had been set up with a firewall that prevented

the software working. In one case, a student who was being sponsored by her employer abandoned the course when her employer refused to adjust the firewall so that she could complete the first CTMA. Others switched to PCs in internet cafés or PCs belonging to friends.

Internal technology infrastructure problems. A number of internal technology infrastructure problems were encountered, all of which could have been avoided. In each case, the IT department had a reason for not having taken the obvious precautions (e.g. unanticipated staff absences, 'costly' alternatives). Yet, for the sake of a small financial investment and a few hours' work by the IT department, students and faculty, at times were placed under considerable stress.

Overload. This was the only technology infrastructure problem that was foreseen by the university's IT experts for which no adequate testing could be conducted prior to the start of the course—it was impossible to simulate up to 500 students attempting the same CTMA at the same time.

Partway through the first CTMA, students began reporting that they were unable to access CTMAs. Sometimes, by waiting a few minutes, they succeeded. If not, waiting until the next day usually worked. Once this problem came to light, students were repeatedly advised to avoid waiting until the last minute to attempt their CTMAs.

Unfortunately, many chose to ignore this advice, resulting in peaks of server accesses over the last weekend of each CTMA. The result was significant access problems and led to considerable ill will and frustration on the part of both the students and the faculty who had to try to fix things in a very limited time.

Connection problems. It was discovered during the first CTMA that students could not get back into the assessment if their PC crashed. The software suppliers had been asked if this might occur and had responded saying that students would be returned automatically to the point they had reached when they left the CTMA. However, no one explained that a different URL would have to be used to log in for this restart facility to work.

It proved difficult to persuade the students to use this different URL announced halfway through the first CTMA. Instead, they became very good at contacting the course team by e-mail, at all hours of the day and night. In order to cope with the problem quickly, a 19-hours-a-day watch had to be maintained during the last few days of each of the CTMA periods. In some cases, even when students did what was asked of them, the restart facility did not work and they had to be given a fresh copy of the CTMA.

In these cases, the two reports generated by *QuestionMark Perception* had to be combined manually so that the first attempt at each question was always used to arrive at the overall score for the CTMA. Students then had to be informed if their score had changed and the manually created report containing their answers had to be sent to their tutor by e-mail rather than via the eTMA system.

The cost in faculty time and student goodwill was enormous.

Server sharing. Despite the software manufacturer recommending that *QuestionMark Perception* be installed on a dedicated server, it was installed on a server shared by very demanding data analysis software. This led to some extremely slow response rates during the OLAs and undoubtedly contributed to the load problems.

When it became clear that this was a problem, the IT department refused to move the software to a dedicated server. It was considered a 'poor use of university resources'.

Faculty felt they knew the cause of the problem, but were unable to tell students anything other than, 'it is being investigated'.

OLA Server Mirroring

The software manufacturer recommended mirroring the server on which the software was installed so that students were able to experience uninterrupted service in the event of any server down time. Once again, the IT department deemed this unnecessary even when it became apparent that it would significantly reduce the incidence of server-related problems affecting the students.

Mirroring of other key servers. Students were encouraged to access the OLAs directly using the CTMA URL but could also access them from the course webpage. When it was down, many forgot that there was another route to the CTMAs and only used it after they had been reminded of the 'direct' URL by faculty monitoring their requests for help. If the course website had been mirrored, this problem would not have arisen.

Backup. The CTMA server should have been backed-up daily. It was not. At one point when the server went down it resulted in an entire week's amendments to the CTMA files and data stored on CTMA performance being lost. Fortunately, this did not happen during a period when students were working on a CTMA. While most of the data were recovered from the copies of the files kept on faculty PCs, some were lost permanently and were rewritten.

Software Problems

Internet delivery. Prior to purchase, the course team was assured that other institutions had used *QuestionMark Perception* to administer tests over the Internet. Therefore, it was assumed that there would be no problems delivering the OLAs over the Internet. However, when problems began to arise relating to internet delivery, it was discovered that these institutions had used intranets for their OLAs.

Browser compatibility. During pre-testing, it was discovered that *QuestionMark Perception* only ran as intended using Internet Explorer. Even the AOL version of the browser proved incompatible. Despite students being advised before the course started that they must use the generic version of Internet Explorer and being provided with a copy of it, some chose not to use this browser.

This caused considerable additional work for the course team during the first CTMA guiding students through switching their browser or explaining in some detail that they would still be able to complete *most* of the CTMA questions if they insisted on continuing to use an incompatible browser, as some did.

OLA cut-off dates. The course team understood from the software manufacturers that the software's cut-off facility would terminate all CTMAs at the designated time. Unfortunately, at the deadline for the first CTMA, it was discovered that it did not. The cut-off facility only prevented students from starting the CTMA.

Very few students continued after the deadline, but those who did appeared to believe it was a glitch that would not repeat and no one did so more than once. However, it was something that needed to be prevented if claims of unfair advantage were to be avoided.

Consequently, at the end of each CTMA, faculty manually closed off each of the incomplete CTMAs. This involved logging in as the student and entering no answer to each of the unseen questions in the CTMA. This was a lengthy and tedious process undertaken after midnight on the night of each cut-off deadline.

Software support. The university had a support agreement with the software supplier, but the response to requests for assistance was often unsatisfactory. The support team was reluctant to engage with many queries on the basis that the software had not been installed on the recommended hardware configurations.

Evaluation of the OLA Strategy

It is essential that any innovation is evaluated to assess its worth. Almost 50% of the students passed the course, which stands comparison with pass rates on the equivalent examinations of the professional accountancy bodies,⁴ and clearly supports the view that the teaching, learning and assessment strategy was appropriate.

To assess whether the OLA strategy had achieved its goal, the OLA marks were compared with those awarded in the final examinations. The results confirmed some formative benefit from the OLAs—56% of the variation in marks in the three three-hour written exams could be explained by variation in the marks for the corresponding CTMAs⁵.

Students, an external assessor (who concentrated on course materials) and an external examiner (who concentrated on assessment) were also asked for comments on the assessment strategy.

The feedback from students was extremely positive. They were invited to respond to an on-line questionnaire at the end of the course. Ninety per cent of the 125 who responded indicated they would recommend the course as a first step to anyone interested in pursuing a career as an accountant. They liked the course materials and they recognized the value of the OLAs in keeping up-to-date with the study timetable and identifying their areas of weakness. Their comments about the OLAs were largely positive (a few complained about the spelling issue and about connection/restart problems) and included:

- What a buzz when the score comes back from a CTMA and you instantly know you have done well.
- Good to consolidate learning as you go along. Continuous assessment is a good way of measuring and recognising what has been learnt.
- You are able to take the test in your own time.
- Good revision tool. Kept me to schedule.

The external assessor is Professor in the field of Accounting at a major UK business school and a specialist in accounting education. He has tutored for the university and has completed four degrees under its distance learning system. Within his final report, he commented:

It seems to me that the various components of [the course] (e.g. teaching material, tutorial arrangements, assessment strategy) are suitably aligned to ensure that the course aims are achieved... The assessment strategy is, in my view, well-designed and highly appropriate.

The external examiner for the course is Professor of Accounting at another UK university with a PhD in the use of IT in accounting education and extensive experience of

teaching and examining accounting in a range of universities in the UK and Ireland. Following the examinations at the end of the first year of the course, he made the following comments concerning the overall assessment of the students:

The assessment strategy is complex, but appropriate as it assisted students in the successful preparation for their examinations ... [and] ... the use of IT generally was innovative and exemplary.

In addition, the accounting profession's recognition of this course as an entry qualification with exemptions from their equivalent level examinations clearly supports the form and content of the course and the nature of its assessment.

Analysis and Review

The analysis presented here is based on the first year of the course. Other researchers (e.g. Stout, 1996) have warned of the dangers of reporting the 'novelty effect' of changes in methods of delivery. However, similar results were achieved with the second cohort of the course.

Completion rates match up favourably with those of comparable courses offered by the university, and student numbers (500 in the first year, 700 in the second and 1000 in the third) certainly made it beneficial from a purely financial perspective to offer the course. Focusing upon the OLA system, the six-figure investment in OLA in this course was only considered worthwhile because of the size of the cohorts and the course's long anticipated shelf-life (at least seven years), which meant that questions would be recycled many times.

However, when the non-financial costs resulting from inappropriate IT structures and problems with the software are taken into account (unpaid faculty overtime and increased levels of stress both for students and faculty), it is doubtful if the pedagogical benefits of this example of internet-based OLA outweigh the human costs of providing it.

Recommendations

This paper reports the experiences of one course team on one course in one university. Nevertheless, there are lessons learnt that should be relevant to anyone embarking on a similar project. They concern what to do and what to avoid if embarking on internet-based OLA:

1. There must be effective project management with commitment to the project by all parties involved;
2. competent technical staff should be involved at all stages of the project;
3. anyone seeking to integrate sophisticated OLA into a course must make their requirements clear and work closely with technical experts from the start;
4. the OLA should have a sufficiently long and stable life to recoup the investment;
5. selection of software is critical—it should be matched to the assessment and the nature of the feedback required (not the other way around) and it should be suitable for the method of course delivery;
6. consideration should be given to buying in third party questions with delivery many months before they will be used, allowing time to check that their terminology is 100% compatible with the course materials and textbooks; and
7. adequate technical and pastoral support should be provided to students throughout the course, but especially during the first OLA that contributes to the course grades.

In addition, the following must all be addressed:

- Infrastructure—its reliability and security.
- Interfacing OLA with other university programmes and systems—will it work? Do routines need to be changed? (e.g. Back-up frequency, writing code to link the OLA system with the student records system.)
- Writing and testing robust questions suitable for OLA—who does what?
- Providing feedback to OLA—do you do it and, if so, how and to what extent?
- Support—the level of IT and pastoral support students require for sophisticated OLA exceeds most teachers' expectations. Plan to provide more than anyone believes is necessary and ensure that all those who will be involved in providing it understand what they are agreeing to do.

Following these recommendations should increase the likelihood that the problems encountered on the *Certificate in Accounting* will be avoided. The resultant reductions in housekeeping stress (experienced by students and faculty) may be sufficient to make the development worthwhile.

Notes

¹In the UK, each year of undergraduate full-time study is normally valued at 120 credits with 360 credits being required for the award of an undergraduate degree.

²The students never visited the University campus. They studied in their own time supported by a virtual learning environment (*First Class*) and tutor-led workshops (groups of 15–20) lasting three to six hours held approximately every six weeks.

³The TMAs required students to prepare financial statements, provide analysis of accounting data and discuss accounting and related management concepts in long-form answers.

⁴For example, the pass rate on the papers at the equivalent level of ACCA's professional scheme (1.1, 1.2, 1.3) reported on www.acca.org.uk/students/professionalscheme/paper1_1/passrates? were below 60% (and in some cases below 50%).

⁵Square of the Pearson Product Moment Correlation Coefficient (R^2)

References

- Albrecht, W. S. and Sack, R. J. (2000) *Accounting Education: Charting the Course through a Perilous Future*, Accounting Education Series, 16, American Accounting Association.
- American Accounting Association (1970) Report of the 1968–69 Committee on the role of the computer in accounting education. *The Accounting Review*, XLV(Supplement), pp. 29–43.
- Boyce, G. (1999) Computer-assisted teaching and learning in accounting: pedagogy or product?, *Journal of Accounting Education*, 17, pp. 191–220.
- Bryant, S. M. and Hunton, J. E. (2000) The use of technology in the delivery of instruction: implications for accounting educators and education researchers, *Issues in Accounting Education*, 15(1), pp. 129–162.
- Murphy, D. P. and Stanga, K. G. (1994) The effects of frequent testing in an income tax course: an experiment, *Accounting Education: an international journal*, 6(2), pp. 279–291.
- Rebele, J. E. *et al.* (1998) Accounting education literature review (1991–1997), Part II: students, educational technology, assessment, and faculty issues, *Journal of Accounting Education*, 16(2), pp. 179–245.
- Sangster, A. (1992) Computer-based instruction in accounting education, *Accounting Education: an international journal*, 1(1), pp. 13–32.
- Sangster, A. (1996) Objective tests, learning to learn and learning styles, *Accounting education: an international journal*, 5(2), pp. 131–146.
- Sangster, A. and Wilson, R. A. (1991) Knowledge-based learning within the accounting curriculum, *British Accounting Review*, 23, pp. 243–261.
- Stout, D. E. (1996) Experimental evidence and recommendations regarding case-based teaching in undergraduate cost accounting, *Journal of Accounting Education*, 14(Fall), pp. 293–318.
- The Times Higher Education Supplement* (2003) ICT in Higher Education Supplement, 7 February.

11. Sangster, A., Stoner, G., and McCarthy, P. (2007), *Lessons for the classroom from Luca Pacioli*, *Issues in Accounting Education*, Vol. 22, No. 3, pp. 447-57 **[60%]**

Lessons for the Classroom from Luca Pacioli

Alan Sangster, Gregory N. Stoner, and Patricia A. McCarthy

ABSTRACT: In 2006, the Teaching and Curriculum Section of the American Accounting Association published a monograph, *Reflections on Accounting Education Research*. It includes a chapter that demonstrates how research into accounting history can be used in the classroom to inform “students about the changing environment and behavior that influences accounting action.” This paper seeks to broaden the applicability of accounting history to accounting education by demonstrating that there are lessons to be learned in both textbook writing and in classroom instruction from the earliest known accounting textbook, the bookkeeping treatise contained within Luca Pacioli’s *Summa de Arithmetica, Geometria, Proportioni et Proportionalita*.

Keywords: classroom instruction; pedagogy; contextualization; accounting education; business education; Pacioli; abbaco schools; textbook writing.

INTRODUCTION

The methods of teaching are the teacher’s craft, and it is through growing in the skills of one’s craft that teachers keep their relationship with their profession alive. To fail to grow is to face the same classroom every day with the same subjects to teach in the same way. The dynamics of the profession is missing, and instead of the challenge of growing and the pride in getting better there is only repetition.

—Jones (1987, 199)

In 2006, the Teaching and Curriculum Section of the American Accounting Association published a monograph entitled *Reflections on Accounting Education Research* (Smith 2006). It includes a chapter that demonstrates how research into accounting history can be used in the classroom to inform “students about the changing environment and behavior that influences accounting action” (Previts et al. 2006, 17). This paper seeks to broaden the applicability of accounting history to accounting education by demonstrating that there are lessons to be learned today in both textbook writing and in classroom instruction from the earliest known accounting textbook, the bookkeeping treatise contained within Luca Pacioli’s (1494) *Summa de Arithmetica, Geometria, Proportioni et Proportionalita* (hereafter, *Summa*).

Teaching and learning environments have changed considerably since the 15th century (even the blackboard was not invented until 1801). However, despite these changes, teaching processes have remained quite consistent over time. For example, instruction in late-15th

Alan Sangster is a Professor at The Robert Gordon University, Gregory N. Stoner is a Lecturer at The University of Glasgow, and Patricia A. McCarthy is a Course Manager at Open University.

The authors thank Sue Ravenscroft and Brian Hentz for their helpful comments and suggestions for revisions, and for the comments and suggestions of the anonymous reviewers and associate editor on earlier drafts of this paper.

century Italy was dominated by lecture or other forms of didactic presentation (the teacher as information giver and authority) interspersed, at least at school level, with students solving practical problems.

In contrast, today's instructors are often seen more as facilitators and guides. However, in many instances, introductory accounting education is still taught didactically in lectures, often closely based around a textbook and the publisher's supporting materials.

There are obvious reasons for this approach, given the size of classes at introductory level, and the not-uncommon use in such classes of relatively inexperienced instructors coupled with students new to the subject. Hanson and Phillips (2006, 1) observe that "for many students, the first accounting course can be intimidating because it seems far removed from their personal lives. Our students may feel they have little relevant knowledge to draw upon when attempting to learn new accounting topics."

To make content more relevant to students, instructors often use analogies that connect with students' experiences and provide linkages to the subject's structural features. In particular, students should be encouraged to follow deep learning strategies that connect to real-world experiences and therefore enhance their understanding, long-term retention, and ability to use what they have learned¹ (Hanson and Phillips 2006, 13).

It is arguable that the adoption of "textbook packages," at least to some degree, helps address this problem. However, building a course around a textbook does not, in itself, engage students with the material they need to absorb and internalize. Even attempts at contextualization of texts through company vignettes do no more than add a nontransferable context to what is being learned. This clearly puts an emphasis on the quality of the textbook package and places responsibilities on faculty using them to ensure that their use achieves more than standardization of content.

Pacioli's work offers a useful way to not only rethink the importance of contextualized learning, but also to acquaint ourselves with the historical underpinnings of context that govern accounting instruction today. The next section presents an overview of Pacioli's life and teaching career followed by a description of *Summa* and the bookkeeping treatise within it. The following section then traces the development of *Summa* and, in the context of modern thinking on the preparation of learning materials, details the highly contextualized style in which material in the bookkeeping treatise is presented. We then present a range of pedagogical devices used in the treatise. The paper ends with some concluding comments on what we, as accounting faculty, can learn from this 500-year-old text.

THE NATURE OF *SUMMA*

Luca Pacioli (c. 1445–1517) was a Franciscan friar, merchant's assistant, a teacher of pre-university students in *abbaco* schools (the schools attended by the sons of merchants and craftsmen²), university professor of mathematics, astrologer to Pope Leo X, and the author of a number of books, largely on mathematics, the first of which he completed in 1470. *Summa* was first published in Venice in 1494, by which time Pacioli had been teaching for 30 years.

Pacioli's *Summa* is comprised of 615 pages of closely printed text—the equivalent of a 1,500 page textbook if it were published today (Pin 1993, 165). Sixteen introductory

¹ See Reckers (2006) for a discussion about the importance of the accounting academy in engendering appropriate learning, skills, and attitudes in future professional accountants.

² In Northern Italy, particularly in Venice, from the 13th century and beyond the end of the 16th century, the sons of merchants and craftsmen were typically taught in these *abbaco* schools rather than in the "Latin Schools" (Grendler 1989; Camerota 2006).

pages are followed by the main material, which is presented in ten primary chapters, printed and separately paginated into two volumes:³

<u>Volume</u>	<u>Chapters</u>	<u>Content</u>	<u>Pages</u>
1	1–7	Arithmetic	222
	8	Algebra	78
	9	Business, divided into 12 sections on various topics relevant to business (the 11th section is the 27-page bookkeeping treatise)	150
2	10	Geometry and trigonometry	151

All the subjects in *Summa* were taught in abbaco schools (Van Egmond 1981, 21–26), schools established through the financial power of merchants for the instruction of their sons (Van Egmond 1981; Grendler 1989; Radford 2003). As a result, the curriculum was entirely focused on the needs of future merchants. *Summa* is now believed to have been written primarily as a text to be used in the abbaco schools (Field 1999; Sangster et al. 2007) and is considered to be the most elegant and most compendious of all the abbaco texts (Rowland 1995).

The pedagogical approach in abbaco schools and in the abbaco texts was “problem-based learning”⁴ contextualized to business; this approach entailed teaching through problems in commercial mathematics to establish general cases and then to extend them and/or demonstrate variants. The approach resulted in learners acquiring transferable knowledge of, and skills in, mathematics (arithmetic, algebra, geometry, and trigonometry) and commerce applicable to virtually all merchandising situations involving manufacturing, barter, and exchange (Radford 2003). Pacioli’s bookkeeping treatise differs from the rest of *Summa* in that it does not follow the abbaco tradition of problem-based instruction. Instead, it is a highly contextualized description of how to do bookkeeping and how to run a business. Among other things, it tells how to record transactions using three primary books (the memorandum, the journal, and the ledger); how to extract and carry forward balances; how to prepare a profit and loss account; and how to calculate net worth. It has been described as reading a transcript of a lecture (Taylor 1942, 196), and through it we can form a view of how bookkeeping was actually taught to students at that time, of what was felt to be important and relevant, and of the pedagogical devices used in its delivery.

When later writers on bookkeeping based their work on Pacioli’s treatise, much of the material it included on morality, ethics, gender, professionalism, and management was discarded. Referring to this, Sy (2005) asks whether there are lessons to be learned today from Pacioli’s coverage of these topics in the treatise and asks for recognition of the “social Pacioli.” There may also be lessons to be learned today from Pacioli’s pedagogy—the “pedagogic Pacioli”—but, first, it is important to establish that *Summa*’s content and style was *planned*. Any evidence to the contrary (e.g., that it was a collection of loosely related, inconsistent, and randomly sequenced parts) would undermine any attempt to treat the bookkeeping treatise within it as an exemplar that may be relevant to modern pedagogic practice.

In this paper, we consider the extent to which Pacioli’s work can help inform our own pedagogy as accounting instructors. Interestingly, Pacioli’s treatise uses instructional devices

³ These paginations are taken from the 1494 edition.

⁴ For an overview of problem-based learning, see Overton (2005); and for a discussion of its use, see Albanese and Mitchell (1993).

that have often been overlooked or forgotten in the same way that his advice on ethics took many scandals and 500 years before being reintroduced into accounting.

THE DEVELOPMENT OF PACIOLI'S *SUMMA* FROM A MODERN PERSPECTIVE

By the end of the 20th century, authorities on the writing of learning materials had reached a fairly consensual position on the activities authors should undertake when preparing texts. Rowntree (1994, 2), one of the U.K.'s leading experts in the subject, suggests that authors need to follow seven stages in developing learning materials. Although Pacioli had no such guidelines when he compiled and prepared *Summa* more than 500 years ago, the following analysis of the text and what is known of Pacioli's life (see, for example, Taylor 1942; Jayawardene 1971; Macve 1996), show that Pacioli appears to have passed through each of Rowntree's seven stages in developing his textbook. This process can neither be claimed for the majority of other abbaco texts, many of which were comprised of a bundle of unconnected notes (Van Egmond 1981, 28), nor can it be claimed for some modern accounting textbooks.⁵

***Summa* and Rowntree's Seven-Stage Model for Learning Material Development**

In this section, we consider both Pacioli's life and the content and presentation style within his *Summa*, all within the context of each of Rowntree's seven stages of learning material development.

1. Specify the Kind of Materials Your Learners Need

The content of *Summa* follows the generic curriculum of the abbaco schools and everything in the book was therefore of relevance to and "needed" by his "learners."

2. Track Down Materials That May Be Suitable

From the beginning of his career as a teacher in 1464, Pacioli is thought to have spent 30 years in gathering material that was used in writing *Summa*. He traveled widely and taught in many different cities (see Taylor 1942). He recorded the material he collected in manuscript texts, the first of which he completed in 1470 (Taylor 1942). He is known to have completed another three abbaco manuscripts, one in 1478, which is considered to have been a first draft of what became *Summa* (see Pin 1993, 171), one in 1481, and *Summa* itself in 1494.

His use of suitable materials from other sources is both stated in the "Introduction" to *Summa* and evident from comparison of its content to that of other abbaco texts. For example, he used 105 mathematical problems that were sourced from one book alone (Singmaster 2006, 54).

Pacioli continued to seek material for the book even while it was being printed; the printer's marks relating to the binding of the book reveal that the treatise on tariffs that follows the bookkeeping treatise, copied in its entirety from another abbaco text (Klebs 1938), was not intended to be included in the book when printing of the preceding 20 pages started.

⁵ Examination of some recent U.K. texts in the context of Rowntree's seven-stage model reveals that, Stages 3, 5, and 7 in particular are, at times, conspicuous in their absence.

3. Evaluate Collected Materials Using Appropriate Criteria

As an abbaco teacher,⁶ Pacioli would have taught everything in the curriculum (Grendler 1989) and would have had many opportunities to test out material he had found in the classroom and adjust it as appropriate to fit the approach he wished to take. In addition, the material he sourced from other abbaco texts had, by definition, already been used in the abbaco schools and was therefore already in a form considered by many to be appropriate.

4. Customize Materials that Are Not Quite Suitable as They Stand

It took 16 years from the completion of his early draft of *Summa* in 1478 for the book to be printed, by which time he had substantially changed the content; therefore, the text within *Summa* that can be identified and attributed to other authors is generally much changed.⁷ While only a small proportion of *Summa* has been translated, the entire bookkeeping treatise has been translated many times. We do not know if it was customized by Pacioli, but there is sufficient evidence to suggest that it probably was. He had the skill and experience to have done so, for he worked as a merchant's assistant in Venice for six years (1464–1470) and operated as a merchant for a few months in 1472 (Taylor 1942). The bookkeeping treatise is also replete with statements on ethics and morality (credited to Pacioli by Sy [2005]), and it starts with a clear statement from Pacioli that he compiled the contents (Chapter 1, as translated by Geijsbeek [1914, 33]), suggesting he put it all together into one document, itself a form of customization. Given the extensive forward and backward referencing in the treatise, it appears likely that Pacioli did customize it for inclusion in *Summa*. Such referencing could not have been in the original texts.

The bookkeeping treatise is a prime example of matching teaching materials to student needs. It contains a large amount of contextual information, thereby enhancing the learners' understanding, long-term retention, and ability to use what they have learned. For example, these excerpts offer advice for what a merchant needs to do when conducting his business (Chapter 4, as translated by Crivelli [1924, 17]):

A merchant rightly resembles a cock which, among other things, is the most watchful bird that exists. In winter or in summer it makes its nocturnal vigils, at no time resting.

A merchant's head is also compared to one that has a hundred eyes; yet these are not enough for him, either in words or in actions.

Another excerpt offers advice for dealing with the clerks in loan houses, or elsewhere, who want to keep accounts in their "own way" (Chapter 17, as translated by Crivelli [1924, 39]):

Woe to anybody who has anything to do with these people.

Therefore if you keep an eye on them at home, and having a chief to look after them at your business premise, they may perhaps carry out their work in good order, though they may show ignorance.

Finally, this excerpt conveys suggestions for dealings with banks. After explaining the general nature of banks and transactions with them and how to enter them in the journal, he deals with the form of transactions and notes (Chapter 24, as translated by Crivelli [1924, 55]):

⁶ Typically, each abbaco school had only one teacher.

⁷ See, for example, Pin (1993, 170) and his discussion of Pacioli's use of the work of Piero della Francesca.

It is true that sometimes it is not customary to give receipts because, as has already been stated, the bank books are always public and authentic; yet it is better for security because, as has been said above, things are never too clear to the merchant.

The contextualization in the treatise goes beyond simply matching the needs of and linking to the knowledge of students so that they learn and understand the material better. Rather, it ensures the appropriateness of the treatise for someone who needed an understanding of *all* aspects of bookkeeping in the merchant environment—not just how “to do” double entry—to ensure bookkeeping was performed appropriately. This context clearly made the treatise suitable for his “learners” and, even more importantly, the abbaco school teachers, many of whom would have known little about “being” a merchant or a bookkeeper, but who could now teach the subject with some confidence.

5. Write New Materials Suited to the Needs of Your Learners

In the “Introduction” to *Summa*, Pacioli states that he did not write any of it. That is, he did not write about any topic in the book from scratch. What is new in *Summa* is not the underlying content, but rather the style of writing:

In it I have tried above all to give the material a practical slant based upon examples of this kind as may easily be seen from the methodical arrangement of its contents. (Translation from *Summa* by Taylor [1942, 190])

Pacioli’s text is replete with practical examples to demonstrate concepts, and he also amends existing problems to make them more interesting and more relevant. For example, a problem he presents in the algebra section is based on a question that was well known and often used in abbaco texts concerning, in Pacioli’s version, a merchant’s dying wishes and the problem in dividing his estate if his pregnant wife bears twins (Pacioli [1494, folio 158r], translation provided by Singmaster [2006, 40] and paraphrased by the authors):

Nofrio Dini of Florence, a respectable merchant in Pisa, at the shop of Giuliano Salviati, told me about such a will on 16 Dec 1486. After a bequest to the church of 200 ducats, there was an estate of 800 to be divided. If a son was born, the mother was to get 400; if a daughter, the mother was to get 300. If twins were born, divide it 3:3:5.

Pacioli then goes on to provide the basis for these divisions and suggests they can be applied to any similar problem, which he promptly does on the next page in relation to selling a pregnant cow. Thus, in Pacioli’s version of this problem, which was commonly used in abbaco texts, a scenario is presented that involves himself and provides a plausible date and names of people involved in the event he describes. As a result, his learners could sense a realism in the problem that was lacking in other versions of the same problem in other texts. It is therefore in the process of contextualizing his text to make it suitable for his learners that Pacioli wrote new material.

6. Edit Materials and Prepare Them for the Production Process

As we do today in our textbook writing, academic writing, and in our teaching, Pacioli linked the material he had selected in a logical sequence, embellished it, contextualized it, and added to it sufficiently to give it his own style and tailor it to his intended audience.

Despite not being common practice in printing at the time, he prepared a section-level contents list at the front of the book: a narrative summary of the contents of each major part of the book in the “Introduction”; a detailed contents list and index for the whole book at the end of the “Introduction”; a contents list and index for the bookkeeping treatise at the front of the treatise; and a contents list and index at the end of the second volume

(on Geometry) relating to that volume's content. Ever the teacher, aware that readers might not realize how they could use these content lists, Pacioli advises them more than once to use them to find material on topics they seek.

7. Evaluate and Improve Your Materials

Pacioli is known to have been teaching at the abbaco level in 1464 and is thought to have continued possibly until at least 1480 (Grendler 2002, 67). Circumstantial evidence in the form of a dedication from a former pupil in an abbaco text published in 1522 (Van Egmond 1981, 30) suggests it was much later that he ceased to teach the abbaco curriculum. This finding is supported by his having been ordered to cease teaching the youth of San Sepulcro in 1491 (Jayawardene 1971), just three years before the publication of *Summa*.

Over these 27 years, Pacioli would have used most of *Summa* in his own teaching. Pacioli enjoyed a reputation as an excellent teacher and an acknowledged proclivity to rewrite other peoples' material. This reputation, combined with the fact that his manuscript of 1478 is considered to have been an early draft of *Summa* and is a much briefer and less comprehensive work, provides strong evidence that Pacioli revised and improved his materials before publication.

Discussion

This analysis demonstrates that Pacioli had little to learn from present-day approaches to the preparation of learning materials. Pacioli's self-confessed rewriting of material to give it a practical slant emphasizes the importance he placed on theory only being useful when applied to practical situations (see Taylor 1942, 138, 195–196). Yet his contemporaries avoided his approach. Despite the clear benefits of the contextualization within the treatise, early writers on bookkeeping removed many of those elements when they wrote their own texts based upon it (see, for example, Fogo 1905; Geijsbeek 1914).

Today, many textual references—the use of the non-existent widget, artificial dates (e.g., 20x7), obsolete products, and out-of-date prices and values in many 20th and 21st century accounting texts—demonstrate how textbook authors have strayed from the clear lesson given by Pacioli on the need to contextualize material consistently in a manner that is relevant and realistic to its readers.

The next section identifies many of the pedagogical devices in the bookkeeping treatise. It is followed by a discussion on what accounting faculty today can learn from Pacioli's approach to textbook writing and classroom pedagogy.

THE PEDAGOGICAL DEVICES IN THE BOOKKEEPING TREATISE

A large number of pedagogical devices are used in the bookkeeping treatise. Among them is the use of Latin to draw attention to or emphasize specific portions of text—a device not dissimilar to the use of marginal icons in modern textbooks, or for emphasis the use of bold, italics, underlining, and/or color, none of which had been invented in 1494, with the exception of two-color printing (which was prohibitively expensive). Using Latin in this way increased the suitability of the text for its users: because it was a “foreign” language it would “leap out of the text” when read.

Other pedagogical devices in the bookkeeping treatise include:

1. Describing at the start what is going to be covered, and why it is relevant to do so; and sequencing the contents so that everything builds on what has come before. Then bringing the treatise to a close by referring back to what was said would be covered at the start, encouraging the reader by exalting its usefulness, reinforcing the message

- to use the table of contents, and then summarizing the most important principles contained within it.
2. Inclusion of a summary of what is coming in the next chapter (often in the chapter titles, which read like summaries rather than chapter titles in the modern sense); what is coming in the next part (Chapter 5 does so with reference to the rest of the treatise); or what has been covered.
 3. Use of backward and forward linking of text using chapter numbers or topic descriptions, thus reinforcing the importance of learning and understanding material as it is covered.
 4. Use of popular sayings and proverbs for emphasis (26 times).
 5. Use of the first person, which makes the style conversational and personal—making it seem as if the author is talking one-on-one with the reader.⁸
 6. Split the subject into its main parts. The first 36 chapters are grouped into two parts, the second of which is subdivided into two further parts.
 7. Use of an untitled “appendix” at the end of the treatise for examples. (This use of an appendix was probably unique in 1494.)
 8. Use of detailed contents lists and providing instruction on how to use them so as to make it easier for a reader to find things (this is not commonplace in modern U.K. accounting texts, though it is more so in U.S. textbooks).
 9. Frequent contextualization—so important for textbooks when the pupils/students have no idea what “real life” is about or how things within it inter-relate—and contextual advice on, for example: auditing; fraud; ethics; gender, religion, and profit (an extremely important matter at that time); banking; and being a merchant.
 10. *Summa* also contains advice on how to teach and offers advice to students on, for example, the impossibility of teachers knowing everything (Taylor 1942, 150–152). This advice is followed in the bookkeeping treatise where instructions and examples are kept simple. For example, there are no composite journal entries described anywhere in the treatise even though they were in common use at the time.

The next section considers what lessons can be learned today from these 500-year-old pedagogical devices, both by textbook writers and faculty.

CONCLUSION: WHAT ACCOUNTING FACULTY CAN LEARN FROM PACIOLI

mio reverendo e eccellente affine et preceptor maestro
[my revered and excellent, willing and perceptive teacher]

—The dedication to Luca Pacioli by one of his students, Stephano delli Stephani, in his own *abbaco* textbook published in 1522 (Van Egmond 1981, 30).

Pacioli’s 27-page bookkeeping treatise contains many pedagogical devices that are seen in some of today’s best textbooks and classrooms. However, it would be true to say that some of them are still not universally adopted in textbook writing or classroom teaching of accounting—how many of us, for example, start our classes by summarizing what we are going to teach and, when finished, confirm to the students that we have done what we said we would do?

⁸ See Rowntree (1990, 207–232) for a detailed explanation of how to write learning materials and of why use of conversational language is recommended.

The frequent references within the treatise to other ideas and concepts along with the broad contextualization of the processes of bookkeeping to legal, social, ethical, and moral codes, as well as to business practice, meant that readers of the treatise learned double-entry bookkeeping in context, rather than by learning how to apply a formulaic approach in isolation from the reality of business. As a result, readers could link what they learned to their own knowledge and experience, see its relevance, and thus gain understanding—something most faculty would aspire to with their students but, as research shows, they do not always achieve.⁹

The bookkeeping treatise includes advice on how to use it. As instructors, we often assume students do not require such advice, even though some modern textbooks are part of an extremely complex bundle of learning resources but contain, particularly in the U.K., relatively little or even no such advice for their readers.¹⁰ There is also the related issue of the confusing range of learning resources in our libraries and online that could assist students, if they know how to use them effectively. Have things changed so much in the last 500 years that we no longer need to advise our students how best to use the complex array of learning resources available to them?

It is doubtful that anyone would disagree that including all the pedagogical devices from the treatise in today's textbooks would help students. However, many textbooks do not incorporate them all. The same applies to classroom practice. By noting and adopting these features found within the bookkeeping treatise, faculty, especially but not exclusively those who lack experience or effective training, may better engage their students, and so make students' learning experience more productive and long-lasting.

Modern thinking on education promotes the use of many of the pedagogical devices that are found in Pacioli's bookkeeping treatise, reinforcing the point that "there is nothing new under the sun" and that, echoing Previt et al. (2006), we can learn from our history. One clear lesson from the bookkeeping treatise is that we should resist teaching accounting as a technical subject devoid of context. Context is essential, as is paying heed to the other relevant advice in the treatise.

For 500 years, accountants ignored the advice the bookkeeping treatise contained concerning ethics, morals, and auditing, and paid the price with massive corporate failures over the last 300 years, culminating in the collapse of Enron, which, in turn, resulted in the failure of one of the world's largest accounting firms. These lessons in the risks inherent in practicing accounting in a contextual vacuum can also be applied to the teaching of accounting, and to the manner in which we teach it in the classroom. There are lessons for us all in Pacioli's bookkeeping treatise, lessons from the "pedagogic Pacioli."

REFERENCES

- Albanese, M. A., and S. Mitchell. 1993. Problem-based learning: A review of literature on its outcomes and implementation issues. *Academic Medicine* 68 (1): 52–81.
- Camerota, F. 2006. Teaching Euclid in a practical context: Linear perspective and practical geometry. *Science & Education* 15 (2-4): 323–334.
- Crivelli, P. 1924. *Double-entry book-keeping, Fra Luca Pacioli*. London, U.K.: The Institute of Bookkeepers.

⁹ See, e.g., Sharma (1997, 135) who observes that "The results are alarming in that many of the students perceive learning as acquiring knowledge rather than as understanding and constructive analysis."

¹⁰ See Phillips and Phillips (2007) for discussion of the need for faculty to provide advice of this type.

- Field, J. V. 1999. Luca Pacioli e le matematica del Rinascimento. Atti del convegno internazionale di studi. Sansepolcro 13–16 aprile 1994. *Burlington Magazine* 141 (1154): 300–301.
- Fogo, J. R. 1905. History of book-keeping. In *A History of Accounting and Accountants*, edited by R. Brown. Edinburgh, Scotland: Augustus M. Kelly Publishers/Institute of Chartered Accountants of Scotland. Facsimile reprint in 2004. New York, NY: Cosimo Books Inc.
- Geijsbeek, J. B. 1914. *Ancient Double-Entry Bookkeeping*. Denver, CO: John B. Geijsbeek.
- Grendler, P. F. 1989. *Schooling in Renaissance Italy: Literacy and Learning, 1300–1600*. Baltimore, MD: The Johns Hopkins University Press.
- . 2002. *The Universities of the Italian Renaissance*. Baltimore, MD: The Johns Hopkins University Press.
- Hanson, E., and F. Phillips. 2006. Teaching financial accounting with analogies: Improving initial comprehension and enhancing subsequent learning. *Issues in Accounting Education* (February): 1–14.
- Jayawardene, S. A. 1971. Luca Pacioli. In *Dictionary of Scientific Biography*, 274–277. New York, NY: Charles Scribners Sons. Available at <http://www.chlt.org/sandbox/lhl/dsb/page.269.php>.
- Jones, F. H. 1987. *Positive Classroom Instruction*. New York, NY: McGraw-Hill.
- Klebs, A. C. 1938. Incunabula scientifica et medica. *Osiris* 4: iv, 1–11, 13–159.
- Macve, R. H. 1996. Pacioli's legacy. In *Accounting History from the Renaissance to the Present*, edited by T. A. Lee, A. Bishop, and R. H. Parker, 3–30. New York, NY: Garland Publishing Inc.
- Overton, T. 2005. *Introduction to PBL*. Hull, U.K.: Higher Education Academy Physical Sciences Centre.
- Pacioli, L. 1494. *Summa de Arithmetica, Geometria, Proportioni et Proportionalita*. Venice, Italy: Paganino di Paganini.
- Phillips, B. J., and F. Phillips. 2007. Sink or skim: Textbook reading behaviors of introductory accounting students. *Issues in Accounting Education* 22 (1): 21–44.
- Pin, A. 1993. The contribution of Luca Pacioli to the development of business accounting. *Economic Notes by Monte dei Paschi di Siena* 22 (2): 161–177.
- Previts, G. J., D. L. Flesher, and W. D. Samson. 2006. Using historical research in the classroom. In *Reflections on Accounting Education Research*, edited by L. M. Smith, 17–43. Sarasota, FL: American Accounting Association Teaching and Curriculum Section.
- Radford, L. 2003. On the epistemological limits of language: Mathematical knowledge and social practice during the Renaissance. *Educational Studies in Mathematics* 52: 123–150.
- Reckers, P. M. J. 2006. Perspectives on the proposal for a generally accepted accounting curriculum: A wake-up call for academics. *Issues in Accounting Education* 21 (1): 31–43.
- Rowland, I. D. 1995. Abacus and humanism. *Renaissance Quarterly* 48 (4): 695–727.
- Rowntree, D. 1990. *Teaching through Self-Instruction*. Revised edition. London, U.K.: Kogan Page.
- . 1994. *Preparing Materials for Open, Distance and Flexible Learning*. London, U.K.: Kogan Page.
- Sangster, A., G. Stoner, and P. A. McCarthy. 2007. The market for Luca Pacioli's *Summa Arithmetica*. Paper presented at the British Accounting Association Special Interest Group in Accounting Education Conference, Wales, May 23–25.
- Sharma, D. S. 1997. Accounting students' learning conceptions, approaches to learning, and the influence of the learning-teaching context on approaches to learning. *Accounting Education* 6 (2): 125–146.
- Singmaster, D. 2006. *Sources in Recreational Mathematics an Annotated Bibliography*. 8th preliminary edition. Available at: <http://www.g4g4.com/MyCD5/SOURCES/SOURCE1.DOC>.
- Smith, L. M., ed. 2006. *Reflections on Accounting Education Research*. Sarasota, FL: American Accounting Association Teaching and Curriculum Section.
- Sy, A. 2005. Resurrecting the social Pacioli: Ethics, gender and other silences. *International Journal of Accounting, Auditing and Performance Evaluation* 22 (4): 441–449.

- Taylor, R. E. 1942. *No Royal Road*. Chapel Hill, NC: University of North Carolina Press. Reprint in 1980. New York, NY: Arno Press.
- Van Egmond, W. 1981. *Practical Mathematics in the Italian Renaissance: A Catalog of Italian Abacus Manuscripts and Printed Books to 1600*. Firenze, Italy: Editrice Giunti Barbèra.

