Development of a Modular Web-based CAL system for Activity-Based Costing
Using Goal-Based Scenarios

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Abstract

A Web-based computer-aided learning system, CABC-2, have been developed using a modular approach. The basic building modules (units) are named individual Web pages or groups of pages. These units can be selected and organized into specific teaching packages, and associated with various types of learners, who can then navigate through the units of the packages through an active concept map-based interface. An active concept map editor makes it easy to create and modify specific packages, and to create the learner interface. The system has been applied to the development of a learning system for activity-based costing, a relatively new concept in management accounting.

Introduction

This project started as two separate investigations which were subsequently integrated. One was the development of a systematic method to develop Web-based computer aided learning (CAL) systems, and the other was the development of practical applications of activity-based costing (ABC), a relatively new costing method in management accounting. The ABC domain knowledge was built up by participation in a consultancy project in helping a company to develop an ABC system for its cost management. Subsequently, the information collected in the development of the ABC software was incorporated in a multimedia computer-aided learning package CABC-1 [Yau & Chan 98]. That package was written in Visual Basic and ran on MS Windows. It was used by university students in the teaching of ABC at the City University of Hong Kong. Feedback from the students were collected and subsequently used to develop the current Web-based, modular version, CABC-2. Individual HTML pages, or groups of pages that are internally connected through hyper-links are “units” that form the basic building blocks of CAL packages. A graphical editor can then be used to select and arrange these units into a structured package, e.g., as an Web-based electronic book with chapters and sections.

Development and testing of CABC-1

ABC as a theory was proposed in the late 1980s [Cooper 1988a]. Traditional cost accounting systems use the classic model of cost distribution which was designed around the factors of production: direct labor, direct materials, and overhead. It has been discovered that this methodology can create a distorted picture of the costs for producing output because of the manner in which costs are allocated to output rather than traced to output. Alternatively, ABC focuses on the activities associated with operating the business. It allows managers to relate costs to activities and products much more accurately than conventional methods. Initially ABC was developed for the manufacturing industry but was subsequently found also applicable for the service industry. By the mid-1990s, a number of companies in the service industry in Hong Kong were trying to adopt ABC but were encountering problems in finding relevant information and references such as case studies, as well as appropriate tools, and there were many false starts. In this environment, a consultancy project funded by the Industry Department of the Hong Kong government undertook to investigate the problem by developing such an ABC model and associated software for a participating local company [Yau & Chan 98]. As a spin-off from the consultancy project, a selection of the information collected and the techniques developed in the consultancy project were incorporated in a multimedia computer-aided learning package, CABC-1. That package was written in Visual Basic and ran on Windows.

In both CABC-1 and CABC-2, goal-directed learning [Ram & Leake 1995] was used as the underlying teaching methodology. It is believed that goal-directed learning, and the associated technique of goal-based scenarios, have these characteristics:
1. Goal-based learning motivates students and builds the skills that we want the students to learn.
2. It can tie together different topics, integrating them in a way which make sense to the students.
3. It must provide a realistic context for the acquisition of knowledge.
4. It must motivate, that is, be interesting and challenging to the students.

CABC-1 was designed to be used by a single user. CABC-1 supports learning and browsing modes. CABC-1 was organized around a series of dialogues between the student, who took on the role of a trainee for a consultant company, and the system, in the form of a number of persons such as the president of the consultant company, the accountant for the company in the case study, an ABC expert, etc. In each scenario, there is a pre-set list of context-sensitive questions that the student can choose to ask, as well as pre-set, context-sensitive answers that the student can select in response to questions posed by the computer. These are actually built-in multiple choice tests disguised as dialogues in each scenario. Each section was self-contained. In fact, they can be rearranged in a different order, to present a different flow, or to suit the need of different learners. To do so, however, requires a certain amount of programming in Visual Basic.

CABC-1 was used in the teaching of ABC in an accountancy course at the City University of Hong Kong in 1997. About 30 university students were given a classroom introduction to ABC and then used the software in a one and a half hour laboratory session. Afterwards, the students were asked to fill out a questionnaire by assigning a score to each statement in the questionnaire. The lowest score was 1 (strongly disagree), highest score was 5 (strongly agree), with 3 being neutral. The questionnaire queried them on two aspects. The first section concerned the effectivenes of CABC-1 in enhancing their understanding of ABC. From the results of the questionnaire, it can be said that the students’ average understanding of these specific aspects increased from a score of 2.3/5.0 to 3.5/5.0 after using the package, an increase of ~52%. These results, although by no means definitive, were encouraging and gave us the confidence to continue our work. The second part of the questionnaire concerned the design details. The students found that the CAL software was a valuable addition to normal classroom teaching (4.0/5.0). A little surprisingly, they also agreed that forcing the student to go through every step in sequence was a good way to ensure that the student learned everything necessary (3.9/5.0). The students were also happy with the table-of-content list, where they can choose the topics that they want to learn (3.8). In general, they were also satisfied with the design of the dialogue interface, the pre-set questions that they can choose from in the interactive dialogues, the use of sound and graphics, etc.

The Concept Map Editor and Interface

In a parallel project, a general concept map editor for the Web [Tsui & Chan 98] was being developed, based on the work on the KMap [Gaines & Shaw 1995a] and WebMap [Gaines & Shaw 1995b] at the University of Calgary. An object-oriented approach has been adopted in the design of the concept map editor. It is hence relatively straightforward to create the nodes and links in these templates as specializations of the generic nodes and links. Other templates can similarly be added with relative ease. The generic concept map editor has already been incorporated in other projects such as CABC-2. Obviously concept maps are useful in CAL packages for representing many different kinds of knowledge structures. In this paper, however, we are particularly concerned with the use of concept maps to organize and represent the structure of the contents of a CAL package, and for navigation between different units in a CAL package. The general concept map editor has been incorporated into CABC-2 for organizing basic learning units into a specific learning package. A node can be created for each selected learning unit, and these nodes can then be linked together to form a navigational path from unit to unit. Subsequently, a learner can click on the icon for the node to invoke the associated learning unit.

Modular CAL Design of CABC-2

Even before CABC-1 was finished, it had become clear, with the development of scripting languages and Java, that interactive Web pages had become practical for the kind of CAL packages we had envisioned. We subsequently decided to embark on a second round of development, to design CABC-2. Based on our experience with CABC-1 and other projects, we set these general design goals for CABC-2:

1. It should be easy to modify the contents of the package on the macro level, by changing the flow between units, adding units, and deleting units.
2. It should be easy to customize the package for learners with different backgrounds and different needs.

In CABC-2, the contents are primarily Web pages. These are simply Web pages which may contain active content such as scripts or even Java applets. An individual Web page, or a group of hyperlinked pages forms a content unit. These units can then be strung together, using the package editor illustrated in Figure 1, to form specific CAL packages. Note the table of contents, represented as an active concept map, in the frame on the right-hand side of the Web page. The teacher can create a new module by using the concept map editor to create content nodes and associate content units to nodes. The concept map is considered active because there is a content unit associated to each node. By clicking on a node, the student can download the content unit into the browser. These nodes can be linked to form a table of contents with chapters and sections as illustrated in Figure 1. In general other types of structures can also be implemented.

![Figure 1. The package editor for CABC-2.](image)

Different kinds of students are presented with different learning modules depending on their background and need. For CABC-2, two kinds of students have been identified: the accountant being trained on ABC, who requires a detailed presentation, and the manager, who requires only an overview. Two learning modules have been created for these two kinds of students. The accountant learner’s module contains more detailed content units, such as the details of how to determine activities, cost objects, and cost drivers. On the other hand, the manager learner’s module requires less detailed content units but more units covering the cost and benefits analysis on ABC. Figure 2 shows a sample of the accountant learner’s interface while using CABC-2. Note the content list represented as an active concept map in the frame to the left of the interface. The concept map acts as an clickable navigational map in this interface. In the right side frame is a content page containing a diagram showing the major building blocks of an ABC system.

Content units are simply individual or groups of hyper-linked Web pages, possibly containing active content such as scripts or Java applets. Hence a learner can navigate within each content unit by following these hyper-links. Between content units, the active concept map implementing the table of contents provides the means for navigation. Web-based CAL packages are typically navigated by following hyper-links. Some also provide navigational aids such as clickable bitmaps or buttons. However, clickable bitmaps are rigid and difficult to modify. Clinkable buttons are similarly difficult to modify for the casual user. Both do not convey the structure of the contents easily and intuitively. Hyper-links, of course, are tedious to modify, trace, and manage, but provide for tight control at the low level. In contrast, the nodes in the active concept map can be repositioned and linked easily to form different kinds of flow and structure, but does not provide the kind of tight control that hyper-links provide. Hence we have provided two different mechanisms for navigation. On the micro-level, within individual content units, hyper-links, scripts, and Java applets provide tight control and fine navigation. On the macro level, clickable, active concept maps provide navigation among contents units.
Summary and Discussion

The paper reports the development of a computer-aided learning system for activity-based costing. Few, if any, such software exist for ABC, a relatively recent accounting technique. An earlier, single user version, of the software developed using conventional methods had already been found to be a valuable tool by university students. The current Web-based version has a modular structure. It allows easy modification of the module structure and adaptation to create variant modules targeted for different users, based on the same set of content units, without programming or even editing hyperlinks. The learner can navigate at the macro-level, between content units, through the active concept map. Within each unit, navigation can be done through hyperlinks.

References


Figure 2. Sample view of accountant learner's interface to CABC-2.