DOCUMENT RESUME

ED 428 727 IR 019 388

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TITLE An Alternative Model of Multimedia Development: Small Projects within an Academic Environment.
PUB DATE 1998-06-00
NOTE 7p.; In: ED-MEDIA/ED-TELECOM 98 World Conference on Educational Multimedia and Hypermedia & World Conference on Educational Telecommunications. Proceedings (10th, Freiburg, Germany, June 20-25, 1998); see IR 019 307.
PUB TYPE Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Business Administration Education; Computer Assisted Instruction; Computer Interfaces; Higher Education; *Instructional Design; Interaction; Investment; Learning Modules; *Material Development; *Microworlds; Models; *Multimedia Materials; Navigation (Information Systems); Student Motivation; Teamwork
IDENTIFIERS *Design Methodology; *Learning Environments

ABSTRACT

This paper reports on a project at Edith Cowan University (Australia) in which a multidisciplinary team designed and created a self-paced learning environment for students to learn about share valuation and investment, with a focus on the inclusion of features that would motivate students to use and engage with the program. The resultant program, "Principles of Financial Investment," was a microworld giving the students realistic insights into the world of share valuation and investment, and was included as a module within the university's introductory finance unit. The following components of the development model are described: (1) information design, including defining the audience, and planning and organizing content; (2) interface design, including determining how the content and interactions would blend, and deciding what metaphor to use (in this case, a stock exchange building, securities institute, broker's office, and participant's office); (3) navigation, including implementation of a nonlinear organizing structure; and (4) interaction design. Problems and advantages of the design approach are discussed. It is concluded that the proposed method worked well. Two figures illustrate the model of the development process, and the four primary navigational structures (linear, hierarchical, nonlinear, and composite) for multimedia. (DLS)

An Alternative Model of Multimedia Development: Small Projects within an Academic Environment

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Abstract: The traditional method of multimedia development is characterised by carrying out a number of processes in a linear fashion. This is an efficient method of development where a number of projects are occurring concurrently, but the lack of client pressure and the flexible skills base afforded by an academic environment provides an opportunity to develop multimedia in a unique, non-linear way. A review of the literature has highlighted the paucity of research pertaining to the development of multimedia programs and reveals the inadequacies of traditional systems design models for multimedia programs. This is particularly true for an environment where the development team frequently come from disparate backgrounds and are contracted from outside the University having little understanding of each other's roles, leading to a breakdown in communications and mis-understandings resulting in an end-product at odds with the initial design concepts. Usually multimedia-based instruction is derived from a detailed preliminary analysis, but the instructional designer also brings personal assumptions to the design which are often not part of the analysis These assumptions are evident in the way in which the program is designed, but may need to be re-examined and new strategies implemented in order to accommodate the ever increasing capabilities of the technologies. Two programs which demonstrate the results of different approaches of two instructional designers will be examined to illustrate some of these points.

INTRODUCTION

A grant of $20,000 was given to a project team to create a piece of instructional multimedia which could replace or supplement existing teaching within a unit in the Faculty of Business at Edith Cowan University. A review of commercially available instructional multimedia highlighted the fact that while the programs were aesthetically pleasing, they had a dry, unengaging feel to them. Analysis of these programs discovered that they were lacking in the areas of interface and interactivity design. When the decision was made to create a self-paced learning environment for students to learn about share valuation and investment, a review of the literature was undertaken in an attempt to determine what features needed to be included to motivate the students to use and engage with the program.

The team in question consisted of an instructional designer/project manager; a content expert and a programmer. Each member of the team was also skilled in at least one other area, for example each team member contributed to the graphics, and the programmer had a strong education background so had an immediate understanding of the needs and wants of the instructional designer, he was also primarily responsible for the production of the media.

At the outset the concern was primarily with initial and ongoing motivation, rather than learning outcomes, and once the elements to be included were identified, a concept map was developed and the program was designed. The resultant program, *Principles of Financial Investment*, was a microworld giving the students realistic insights into the world of share valuation and investment—a module within the introductory finance unit in the Faculty of Business.

Ten basic elements of program design modified from those identified by Duke (1980) were used to inform the design approach, with a focus on cognitive and affective aspects of the program's scenario, steps of play, and learners' roles to name a few.

This approach dictated many of the early design and development decisions where objectives were defined in terms of the programs interface rather than learning outcomes. The use of the term interface in this paper is used to describe the bridge between the content and the participant. It encompasses the organisation of the material, the screen design and layout, the use of the space and the way in which the participants moved through the program. Because of the complexity of the program, it was decided to break it into three main domains based on Gould's (1995) model. These domains are information design (content), interface design and interaction design.

The development model is illustrated in Figure 1. It shows the various stages the development team moved through when designing the program. Analysis and implementation are shown as being fairly discrete elements, but the information, interface and interaction design were done concurrently in an attempt to create a cohesive whole. In other words the team wanted an environment where the student moved effortlessly and seamlessly, with little cognitive effort expended on working out where they were, what they were doing there and how to move around. The authoring and media were created and constantly modified in conjunction with these three design domains, the whole process being iterative.

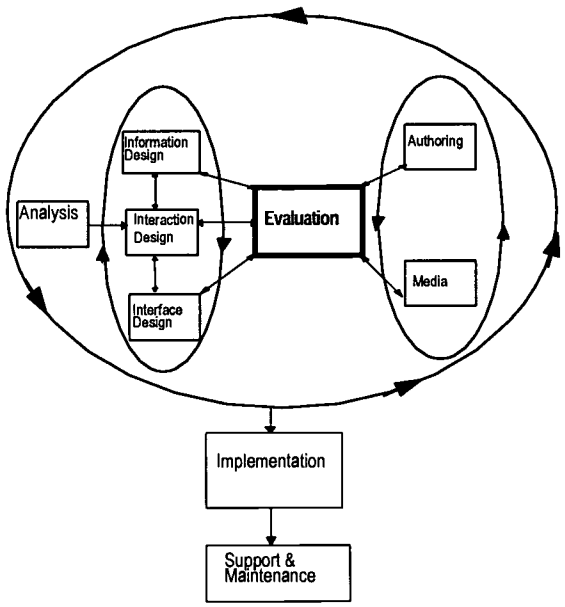

Figure 1: Model of Development Process

INFORMATION DESIGN

The first step in information design was to define the audience and plan and organise the content. A concept map was used to blueprint the content and to define the relationship between each of the elements. It was decided that a microworld would keep the context authentic while allowing the designer to incorporate some gaming elements necessary to keep the learners engaged and on-task. The potential of microworlds to combine didactic theory with simulated practice (Rieber, 1992) was viewed as advantageous in this product, and was difficult to achieve with other solutions.

A target audience analysis was conducted to determine the type of student who would be using the program and it was discovered that it had to appeal to both sexes, a variety of cultural groups, and an age range of 18 to 55. It was decided that it was important that the student be considered a participant in the process, rather than just as a user of the product. Considering the range and tastes of the participants was an important first step in the design of the program (Gould, 1995; Laurel, 1991).

Although storyboards were produced for *Principles of Financial Investment*, they were used more as a starting point. As the model shows, evaluation was an ongoing and constant process and minor adjustments were constantly made to the program. These were arranged mostly through emails rather than re-writing of storyboards. Archiving e-mail messages provided an audit trail for modifications made to the final product.

INTERFACE DESIGN

This process was guided by assumptions that best user interface demands the least learning effort" (Vaughn, 1994) and that the interface connects the learner and the content and helps to shape the interactive experience. "It is everything a user sees, hears, touches and feels. An interface must be functional and aesthetically pleasing and provide the information access and guidance that users need without hindrance" (Francois, 1996).

In this phase it was determined how the content and interactions would blend. The look and feel of the program was decided and the manner in which the content was accessed. A conscious decision was made to keep the interface simple, with cartoon style 8-bit graphics rather than realistically rendered images. This meant that the images took up very little memory and used minimal space, therefore being able to be used on fairly low level equipment. It also meant that the interface could be developed quickly and cheaply, allowing design efforts to be focussed on the educational elements of the program.

A first person approach was used, where the participant enters his or her name and they then become the "owner" of the share portfolio and the office. First-person sensory qualities are important in creating satisfying human-computer experiences and present *experiences* rather than *information* (Laurel 1991). As Laurel points out "Learning through direct experience has, in many contexts, been demonstrated to be more effective and enjoyable than learning through *information communicated as facts*" (Laurel, 1991:119). This use of the first-person also overcame the problems of gender-bias and cultural and age differences.

A key step in the interface design was deciding upon a metaphor to use. In this case the form did infer the function in that the metaphor of a stock exchange building was an obvious choice, together with the attendant industries—a securities institute, broker's office and participant's office.

NAVIGATION

The navigational map outlined the connections or links among the various areas of the content and formed an "organiser" of the content and messages. There are generally four fundamental organising structures used to navigate around a multimedia program and often they are used in combination:

- **Linear**—the learners will navigate through the program in a series of sequential steps;
- **Hierarchical**—learners navigate along the branches of a tree structure that is shaped by the natural logic of the content;
- **Nonlinear**—learners navigate freely through the content;
- **Composite**—learners may navigate in a nonlinear fashion, but can be constrained by linear presentations of items such as movies or critical data which is logically organised in a hierarchy. (adapted from Vaughn, 1994)

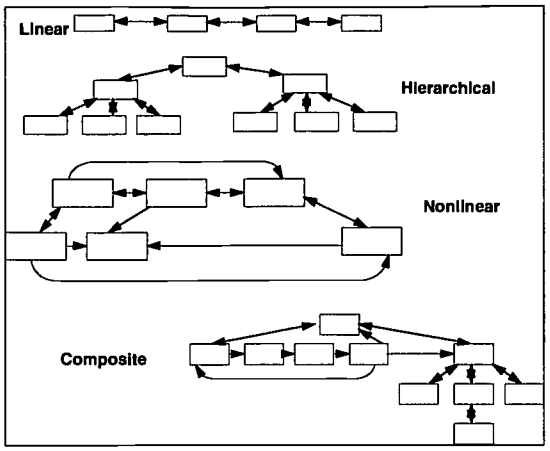

Figure 2: The four primary navigational structures for multimedia as outlined by Vaughn (1994)

Navigation is an essential component of interface design. In this program, it was essential that the students felt that they could move at will wherever they wished within each warp as "this empowers them within the context of the subject matter" (Vaughn, 1994: p 393). For this reason, a non-linear structure was implemented, allowed free navigation around the various 'rooms' of the microworld while diegesis and narrative flow was maintained by linear progression through financial quarters or 'Warps'.

Learners will often construct spatial mental models in order to move freely around a program and within the learning spaces and this has obvious implications for design (Sellen & Nicol, 1990). Designing a program which allows the learner to intuitively navigate using their mental model reduces their memory load and cuts down on the amount of time it takes the learner to learn to use the program. A navigational blueprint on the wall of each "room" in the program was used to assist in the users' construction of a mental model of the program structure and to provide an intuitive way of allowing the participants to move through the program. Clicking on doors in rooms allowed them to get into ante-rooms in a natural way.

INTERACTION DESIGN

Interactivity is the most recent component of IMM and has not yet evolved to the point where it is a communications device (Gould, 1995). Interaction design determines how the program works and how the learner acts within the program. Navigation and control are decided and outlined in the storyboard (Francois, 1996). "The storyboard is an extension of the concept map and is a rough approximation of what the end user will see and do on every screen. The objective is to keep the user oriented to the content through a system of controls and feedback" (Francois, 1996). As stated earlier, the storyboards were used initially and then supplanted by a more informal style of updating via the email. The nature of the interactions were carefully considered for *Principles of Financial Investment* and it was decided that the elements and techniques should be very different from those in mainstream computing systems. Buttons and menus were eliminated where possible as they denote a productivity device and this program aimed to keep the participant on task for as long as they needed in order to acquire the information, solve problems and make decisions; by engaging over time, the participant will experience a sense of change (Gould, 1995). Once the participants got used to the interface it was anticipated that it would become "invisible" to them so that they could get on with *experiencing* rather than *using* the program. In other words, the program should be simple but engaging.

A first-person perspective within an authentic setting provided for a more realistic and meaningful experience which encouraged users to take longer over investment decisions and problem solving, considering all the possibilities. The ability to view an expert and compare their own decisions with the experts in light of the theoretical foundations presented in the program would also impact on the nature of the interactions.

Usually in a computer system, the user must have a degree of competence in order to access the information in it. This program was designed for learners with a limited background in computing and was created to support browsing to permit a more flexible means of accessing the data. Although there was an optimum, primary path through the program, the non-spatial organisation permitted flexible browsing. Browsing is possible only if the

multimedia is interactive and non-linear. Due to the fact that the learner can move through the program in any order, they can use the simple navigation system to constantly check elements such as economic forecasts, theory elements from the Institute and company background information held in the Broker's office. This was considered to be important in assisting the students to achieve the learning objectives.
Although a microworld was selected for the program design, a way of teaching the theoretical components without having the students wade through screens of text was necessary. The theory also needed to be presented in a way which was consistent with the authentic context of the rest of the program. It was decided to simulate an internet environment which allowed the use of hypertext links and slide shows if necessary. This environment also allowed the students to save their tutorial materials to disk, print them out and use the search facilities.

PROBLEMS OF THE APPROACH

The approach to development of *Principles of Financial Investment* was informal. This worked well for the three people in the team who communicated by email rather than in regular meetings and who worked collaboratively, sharing responsibilities and tasks. This approach would not work well in a team consisting of more people, or even in a commercial organisation where the responsibilities are more clearly delineated.

This approach is also fraught with danger. Should the programmer suddenly leave the team, there is no catalogue of media or programming style guide. So, although it worked well in this instance it is not the recommended method of development.

The use of this model is very dependent on the team members working together and working consistently. Some problems were encountered when the content expert became too busy to create some of the materials. In the more traditional approach, materials are created before programming starts therefore avoiding some of the bottlenecks experienced.

A "Waterfall" approach has benefits in that inconsistencies in style or content are weeded out much earlier. The team experienced some difficulties in changing elements consistently through the program.

This approach may not work as efficiently as the "Waterfall" approach for a straight presentation style program. Different approaches tend to produce different results.

ADVANTAGES OF THE APPROACH

One of the greatest strengths of this approach was the multi-disciplined nature of the team. This allowed an exchange of ideas and spontaneous development of the program not usually encountered in a traditional development team.

The speed at which the development took place was a distinct advantage. There was no need to wait for weekly meetings—all members of the team had access to each other at all times via the email system and turn around time on solutions to problems was therefore very fast.

CONCLUSIONS

In an academic environment, the method proposed here for *Principles of Financial Investment* worked well. A working model was produced quickly and cheaply and could start being tested with students within a relatively short period of time. However, it should be noted that this method may not have worked with other projects. This approach relies heavily on the synergy between team members and their iterative approach to design. If the aim were to develop a larger, maintainable learning system, the model adopted here may have proven to be too unstructured to support a necessarily higher level of management control. But it is likely that a program such as *Principles of Financial Investment* would have lacked many of the motivational features which made it successful if it were created under a linear development model. The multidisciplinary nature of the design team and evolutionary approach to development adopted for this project allowed for a unique organic synthesis of form and content into a more cohesive whole than would have been possible under traditional development models.

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