

DESIGNING AND IMPLEMENTING HYPERMEDIA COURSEWARE TOWARDS A SUCCESSFUL LEARNING ENVIRONMENT

by Dennis Ramiro M. Sangalang, MSIT

e-mail add: dsangalang@eudoramail.com

mobile no: 0917-511-0876

ABSTRACT

This research work presents a generic and systematic methodology for the design and implementation of a CD-ROM based interactive hypermedia courseware. Hypermedia courseware is a user-centered system that is based on the hypermedia paradigm, e.g., they are a network of nodes connected by links and they administrate a user model to adapt themselves dynamically to the teachers and students.

This methodology consists of incremental and iterative development process that supports the entire lifecycle of hypermedia / multimedia courseware from problem definition to maintenance and includes various issues such as design creativity, pedagogy, cognitive and technical.

This research work also presents nine instructional events related to pedagogical issues. These include the following: a) gaining attention; b) Informing learner of lesson objective; c) stimulating recall of prior learning; d) presenting stimuli with distinctive features; e) guiding learning; f) eliciting performance; g) providing informative feedback; h) assessing performance and l) enhancing retention and learning transfer.

Systematic evaluation procedures are also described wherein ten User Interface Dimensions are adopted to judge the usefulness and effectiveness of the instructional multimedia and hypermedia courseware. These include a) ease of use; b) navigation; c) cognitive load; d) mapping; e) screen design; f) knowledge space compatibility; g) information presentation; h) media integration; l) aesthetics and j) overall functionality.

Recent research findings related to the impact of the use of instructional courseware as part of the instruction management are also presented.

INTRODUCTION

Rapid advances in information technology have spurred the development of innovative packages for educational and entertainment purposes. The market is flooded with multimedia materials designed by information technology experts and computer engineers. The more enterprising educational institutions have begun empowering their teachers to use courseware as part of their teaching strategy. ([www.albany.edu/mmh/vol 3](http://www.albany.edu/mmh/vol3))

With the rapid developments in information technology, educational institutions have to re-engineer their curricular offering and to institute programs that will upgrade teacher's competencies and delivery of lessons. This is a globally felt need but is more pronounced in developing countries like the Philippines.

The challenge faced by educators in the Philippines is on how to prepare and empower the students to become strengthened and democratic citizens capable of surviving a global environment which has become intensely competitive. (Alcala 1998)

In response to this need, the then Department of Education and Sports (DECS) issued two significant directives to support its modernization program. These are : 1) Order No. 59 series 1999 under which the Center for Education and Technology was created ; 2) DECS Order No. 71 series of 1996 which directed undersecretaries , bureau directors, regional directors, school superintends and presidents of state colleges and universities to establish pilot elementary and secondary schools which are independently to be referred to as *School of the Future*.

Both directives underscore the use of more innovative teaching strategies and approaches through the utilization of multimedia materials. The directives are also in consonance with the principle that learners retain most of what they had been taught if all the senses are involved . A

cut and dried on lesson in Mathematics, for instance , could be transformed into a more creative and interactive session through a multimedia presentation . Studies are replete with testimonies from students and teachers who attest to the retentive effectivity of multimedia instructional materials as shown by the following excerpt :

(Arenas, 1999)

Indeed, as compared to the traditional lecture or seminar format, the incorporation of multimedia lesson presentation is more effective.

There is an abundance of commercially made multimedia materials in the market today. A number of educational institutions have been using these materials - many of which are produced by experts who probably are technocrats without any background in teaching. Some courseware developers are not really teachers but they are very knowledgeable in the aspect of the right tools to be used in courseware development. With this, the pedagogical issues are not being considered and incorporated as part of the ingredients to ensure successful learning experience of learners in using the courseware. It has been found out, however, that a number of existing courseware while often technically adept lack quality or are not suitable to students' level. Moreover, there are certain dimensions only the users of the program could effectively execute. . (www.albany.edu/mmh/vol)

Unfortunately, many educators do not know the appropriate conceptual framework or methodology in which to incorporate computer-based materials into their teaching. One way of solving this problem is to provide educators a methodology, which would enable them to design and develop their own courseware.

Equipping teachers with courseware know-how and skills would not only result to a more productive transfer of learning but more importantly it would release the teachers from depending on commercially produced software.

RESULTS AND DISCUSSIONS

Pedagogical Issues on Courseware Design and Implementation

Stages conceptualized by Gagnz (Gagnz et. al. 1979) regarding the nine instructional events that should normally be followed in sequence as part of the learning materials.

Stage 1: Gaining attention

Learners should be motivated to want to learn and in the teaching – learning process could take the form of intrinsic motivation or extrinsic motivation. In an ordinary classroom situation, teachers resort to one or two motivations to arouse their students' interest. One strategy commonly used by teachers to get their pupils to participate is to ask motive questions. Motive questions are questions the answers to which would spring from the students' everyday experiences. Other strategies which could effectively be used to motivate pupils to participate are: the use of praise , giving of a star or a medal for good performance, being assigned as a group leader. etc. Similarly, this courseware is designed to ensure that the users would keep on using the courseware until such time that they mastered as its functions. Unlike the prevailing pupil – teacher relationship where interest and control could be sustained through human interventions and interactions, a courseware would have to be dependent on a multitude of factors such as: use of appropriate color, design, sound, animation and other technical aspects crucial to achieving harmony and beauty, to sustain the users' attention and interest.

Stage 2: Informing learner of lesson objective

For learning to take place, learners should be able to see the connection of the new lesson to the old. A well-designed courseware should have clearly –stated and well-defined objectives so as not to confuse the users.

Stage 3: Stimulating recall of prior learning

It is acknowledged that review is an important tool in helping learners retain what has been taught. Aside from review, which could be in the form of a question –and-answer strategy, conducting drill exercises also help in memory retention. A well-designed courseware should contain these features.

Stage 4: Presenting stimuli with distinctive features

The stimuli to be used in teaching should be appropriate not only to the subject –matter but also to the level of the learners' understanding and interest. A courseware should also function in the same manner. It should be comprehensive but not too cluttered with details that tend to confuse rather than enlighten the users. It should be direct and written in a simple manner and language but not too simplified that significant information are left out.

Stage 5: Guiding learning

The progressive approach to teaching makes the learners the center of the educative process with the teacher acting as a facilitator or a guide. This approach encourages independent thinking, critical and analytical thinking. It also encourages teachers to be creative in their teaching strategies.

A courseware, which guides the users step by step to graduate from one phase of learning experience to another, also assumes the role of a facilitator or guide. Feedbacks therefore are provided to enable the users to check the correctness or wrongness of what they are doing.

Stage 6: Eliciting performance

One way of validating or confirming answers given by the learners is for the teacher to encourage maximum participation. A good classroom discussion is one in which the learners are encouraged to reason, to debate, to question, to give their opinions and to ask questions.

A courseware should also be capable of eliciting performance through the provision of information, which would allow for users' participation.

Stage 7: Providing informative feedback

Feedbacks are important to the teaching-learning set-up. A teacher who is not able to supply informative feedbacks dampens the learners' enthusiasm for further learning. A good teacher is therefore well read and therefore well informed so that he / she could supply what might have been omitted in the textbooks.

Stage 8: Assessing performance

Learners would want to be appraised as to the extent of their learnings. Teachers too need to have tools for assessing performance. Some of these tools are: quizzes, recitations, homeworks, experimentation and the like.

Stage 9: Enhancing retention and learning transfer

Learning is best retained when the learners are given the opportunities to put into practice theories taught in the classroom. Retention is reinforced if activities and examples given are relevant to the experiences of the learners.

User Interface Dimensions on Courseware Testing and Implementation

The principal objective of the testing phase is to integrate the product in the user's environment and correct the operational version until customers provide positive acceptance tests.

At the beginning of the testing phase the system has reached initial operational capability. In addition the results of the testing workflow are available to remove the last bugs and maintenance.

The testing phase focuses on the establishment of the final product in the operational environment and on the evaluation of the project. To perform the testing, group of students has to test the application before implementing the courseware to all students concerned. This group must attempt to simulate the actual use of the courseware.

Thomas Reeves (University of Georgia) and Stephen Harmon (University of Houston at Clear Lake) have produced a paper, "Systematic evaluation procedures for instructional hypermedia/ multimedia", in which they espoused the use of ten User Interface Dimensions. At the moment, these interface dimensions appear to be the best tool available to help judge the likely usefulness of courseware.

During the testing, the following should be used as part of the basis to ensure the effectiveness of the courseware:

- *Ease of use*

This dimension is concerned with the user's ability to interact easily with the courseware. At one end of the continuum it will be "difficult" and at the other "easy".

- *Navigation*

Can the user move through the contents of the courseware in an "intentional manner"? Again, this can be represented as either "difficult" at one extreme or "easy" at the other.

- *Cognitive Load*

This dimension is concerned with the learner's ability to recognize options, think about a choice and take some action to make that choice. This user interface can be seen as "unmanageable" at one extreme to "manageable" at the other.

- *Mapping*

This refers to the courseware's ability to track and graphically represent to the user the path through the program. This dimension can be shown as "none" or "powerful".

- *Screen Design*

This is a very subjective dimension, but there are established design principles set out. It is whether these principles have been "violated" or "followed" that is measured. (The Principles of Screen Design for Computer Based Learning Materials by Alan Clarke, gives a good grounding in the issues surrounding good screen design.)

- *Knowledge Space Compatibility*

Reeves and Harmon say "Knowledge space refers to the network of concepts and relationships that compose the mental schema a user possesses about a given phenomenon or topic." This means that the user, when using the courseware and initiating a search, must receive information that fits into his/her current understanding of the topic. If it does not ,it is "incompatible". If it does , it is "compatible".

- *Information Presentation*

This dimension is concerned with the presentation of the information in the "knowledge space". . The information must be presented in a form that is understandable to the user. In judging this dimension it is either "obtuse" or "clear". Reeves and Harmon used the following analogy to explain this dimension: "Imagine a video presentation on surgical techniques for angioplasty, directed and produced by Andy Warhol ... the information requisite for understanding may be present, but would probably be difficult, if not impossible, to comprehend".

- *Media Integration*

This dimension refers to how well the media used combine to produce an effective whole. The media could be text, graphics, sound, animations, still and moving video. At our present stage of development, few examples of courseware use all available forms of media. It is important to consider the media that are used and establish whether they are "uncoordinated" or "coordinated".

- *Aesthetics*

Like screen design, this dimension is very subjective. It is assumed that the designer has a full understanding of his audience to enable him to decide whether the courseware aesthetics (or elegance) is "displeasing" or "pleasing".

- *Overall Functionality*

This dimension relates to the "perceived utility" of the courseware. Does it meet the learning objectives for its intended audience? This dimension ranges from "dysfunctional" to "highly functional".

Research Results on the Effectiveness of Hypermedia / Multimedia

Over the last 15 years, a number of research studies have shown the effectiveness of multimedia to deliver training. Adams explored six studies conducted by the U.S. Army, IBM, Xerox, United Technologies, WICAT, and Federal Express that compared multimedia to classroom instruction (Adams, 1992). Miller analyzed over 30 evaluative studies that conducted the same comparison (Miller, 1990). And, Wright examined approximately 25 studies comparing multimedia to classroom instruction on a number of variables (Wright, 1993).

The research findings of the researchers can be broken down to the following categories:

- *Less time needed to train.*

Training compression, the amount of time it takes students to complete an interactive course compared to classroom, was reported between 25-75% for interactive.

The learning curve relative to the amount of time it takes learners to reach mastery of their course content was 60% faster for multimedia learners compared to classroom learners.

- *Higher student achievement/job proficiency.*

Learning gains of how well students performed on final tests or comparisons between pre- and post-test were analyzed for multimedia and classroom subjects. Gains

for multimedia students were found to be between 38-56% greater than their classroom counterparts. Three other studies found a significant difference in gains for multimedia students. Concerning how consistent the interactive learners' understanding of content was compared to the classroom learner (consistency of learning), the interactive learners' understanding of the content was 50-60% more consistent.

- *Higher content retention.*

Students receiving multimedia instruction had a 25-50% higher retention rate compared to those receiving the same content through classroom instruction. Content retention refers to the learner's ability to recall content days, weeks, or months after the initial training is completed. It is a measure of how much content reached long-term memory.

- More consistency in delivery of content.

Multimedia learners had a delivery variance of between 20-40% less than their instructor led counterparts. The slight variance for the multimedia learners can be attributed to the different paths available to the students as they progressed through the interactive courseware;

- *More student/course satisfaction and motivation.*

Several studies reported high student satisfaction with multimedia training because they felt they could move at their own pace, were more involved in their own learning process, received individualized responses, and had privacy. (Perry, T., 2003).

CONCLUSIONS

It is clear that the following play vital role in the design, development and implementation of a hypermedia courseware: 1) The recognition of the problem by means of gathering and analyzing

the existing resources including syllabus, curriculum and lecture materials and the identification of the target group and their basic skills in computer operation; 2) The most important factors that influence the activities of the workflows in the problem definition phase are: a) current information, information sources and information structure; b) current instructional events; c) stakeholders;

The design phase focuses on analysis and design as well as on iteration planning and verification of the design. There are many factors, which influence the activities of workflow in the design phase. These factors can be classified into: a) design creativity; b) cognitive issues; c) technical issues and d) pedagogical issues. Design creativity includes the following: a) user model design; b) navigation design; c) presentation design); d) user interface design. Designing the user interface of the courseware should use guidelines that include: a) Menu; b) Text; c) Colors; d) Buttons and e) Icons.

The most important factors that influence the activities of the different workflows in the development phase are: a) media components availability; b) dynamic page generation; c) user behavior observation; d) adaptation engine; e) usability.

Testing the courseware by means of debugging errors and finalizing the information requirements should adopt the following guidelines: a) Ease of use; b) Navigation; c) Cognitive Load; d) Mapping; e) Screen Design; f) Knowledge Space Compatibility; g) Information Presentation; h) Media Integration; i) Aesthetics and j) Overall Functionality.

References

A. Books

Avison, D.E., Fitzgerald, G, (1990). Information Systems Development: Methodologies, Techniques and Tools, Blackwell.

Best, J.W., & Jahn J. V. (1998). Research in Education (8th Ed.). Singapore: Allyn & Bacon

Black, T.R., Hinton, T, (1988). Courseware Design Methodology: The Message from Software Engineering, Aspects of Educational and Training Technology

Cates, W.M., (1992). Fifteen Principles for Designing More Effective Instructional Hypermedia/Multimedia Products, Educational Technology

Child, D., (1991). Psychology and the Teacher, 4th edn., Cassell.

Gagne, R.M., Briggs, L.J and Wager, W. W., (1989). Principles of instructional design (4th edition), Orlando, Florida. Harcourt Brace Jovanovich Press

Jonassen, J.D., (1990). Hypertext/hypermedia. Englewood Cliffs, New jersey. Educational Technology Publications

Landa, R.K., (1984). Creating Courseware: A Beginner's Guide, Editor M. Feldman, Harper and Row.

Pressman, R.S., Sommerville, I., (1992). Software Engineering, 3rd edn., McGraw Hill.

Reeves, T.C., (1992). Evaluating Interactive Multimedia, Educational Technology, vol. 32, pp 47-53, May.

Schiwier, R.A. and E. R. Misanchuk, E.R. (1993). Interactive multimedia instruction, Eaglewood Cliffs. New Jersey. Educational Technology Publications.

Smith, P.L. and Ragan, T.J. (1993). Instructional design, New York, Macmillan Publishing Company.

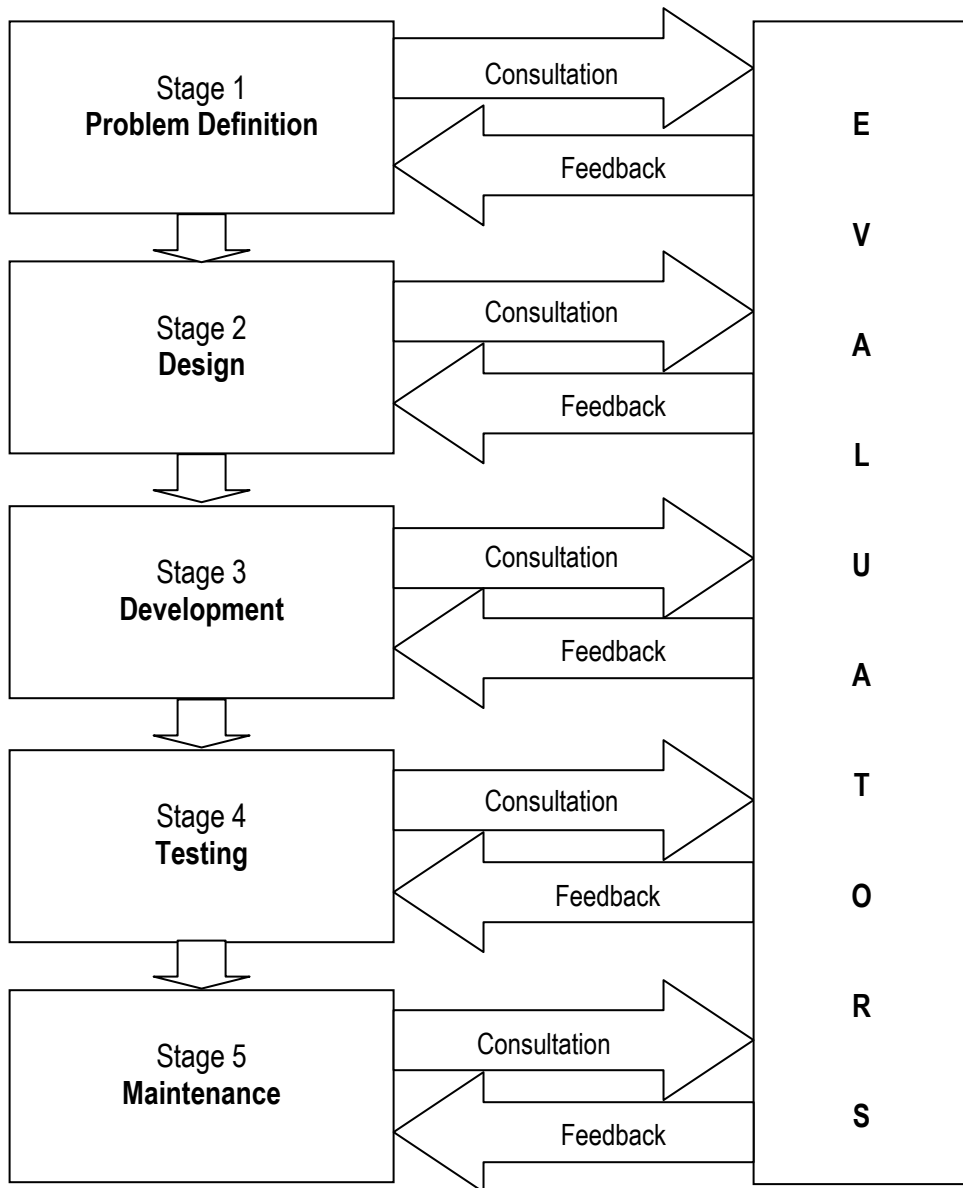
Tannebaum, R. (1998). Theoretical foundations of multimedia. New York. Computer Science Press
Technology Based Learning and Research, Instructional media design on CD-ROM. (1994). Tempe, Arizona. Arizona State University Press

Ulrich, K. (2001). Macromedia Flash for Windows and Macintosh, Peachpit Press.

B. Websites

- Edwards, J. (2000) Judging the Usefulness of Courseware. Available from <<http://www.elsevier.com/homepage/sab/jdentet/contents/judging.html>> Accessed on December 11, 2003
- Hick, S. (1997) Benefits of Interactive Multimedia Courseware. Available from <<http://www.carleton.ca/~shick/mypage/benifit.html>> Accessed on December 10, 2003
- Lai, Y., and Waugh, M.L. (1995). Effects of three different hypertext menu designs on various information searching activities. Journal of Multimedia and Hypermedia. Vol. 4 Iss. 4. Available from <gateway proquest. Com .did =7220150> Accessed on Aug. 11, 2003
- Marshall, D(1999) Interactive Courseware Development. Available from <<http://www.ulst.ac.uk/cticomp/monitor11/dmarshall.html>> Accessed on December 11, 2003.
- Poncelet, G. and Proctor, L. (1993). Design and Development factors in the production of hypermedia-based course. Canadian Journal of education Communication. 2292). Available from<atl.ualberta.ca/bonnie/reference.ht> Accessed on Jun 21, 2003

Figure



Note: Evaluators include subject expert, I.T. expert and users

Figure: Researcher's Theoretical Approach Model