

Designing Web Based Study Guides for Distance Education Courses¹

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Abstract

World Wide Web is actually used for a broad range of educational applications. One of them is concerned with the delivery of course material for distance education. This paper discusses the application of Web to the development of study guides. An object-oriented method is proposed for dealing with the process of analysis, specification, design, production and delivery of a Web-based study guide for distance education courses. The method focuses on four essential components of a study guide : its structure, its user interface, its content, and the teaching-learning process to be applied. The application of the method may benefit the implementation of distance education courses in two respects. First, it helps to produce effective Web study guides of high quality. Second, it helps the development team to organize, plan and control the different activities involved in the development of Web study guides.

Keywords : Web-based Distance Education, Web application design, Web authoring, Object-oriented methods.

1.- Introduction

Study guides are central to distance education courses. They are one of the most common and important instructional materials used by distance education courses. A study guides provides an organization and structure for a course. It not only describes the subject matter but contains guidance and directions about the activities to be performed by both the students and the instructor.

A distance education course is normally based upon a combination of different technologies and media (e.g., print, audio/videocassettes, radio and television, videoconferences, and computer-based instructional modules). Additionally to its guidance purpose, a study guides behaves as an integration tool, i.e., as a framework that links objectives, course contents, learning and evaluation procedures, media and technologies used, etc. It also indicates when, how and where a media should be used to cover a particular objective of a course.

A study guide differs from a textbook in several aspects : (1) A textbook communicates information, whereas a study guide communicates teaching ; (2) a textbook is intended to be read linearly, that is, from the beginning to the end ; the structure of a study guide is hierarchical instead of linear ; (3) a study guides involves additional activities other than reading, including writing, viewing, listening, practicing and testing ; it also indicates the forms of interaction

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between students and instructors, and between students themselves ; and (4) contrary to a textbook, a study guide carries the student through the learning process by using several resources or media to cover the course contents.

According to Moore and Kearsley [1], a typical study guide should contain the following elements:

- An introduction to the course including a description of goals and objectives.
- Self-contained lessons or units which present the information associated with each objective. Units are the core of a study guide, each of them includes the following :
 - instructors commentary and discussion,
 - associated readings,
 - other media related to the objective, and
 - written assignments.
- Directions for using the instructional material
- Directions for the preparation and submission of assignments
- Annotated bibliography
- Grading Scheme and other course requirements
- Study Techniques
- Self testing questions
- Schedule of specific lessons and activities
- Information about how and when to contact the instructor

Web hyperdocuments are becoming one of the most common media being used for developing study guides. The Web media is preferred over other technologies, such as satellite teleconferences, television, computer-based videoconferences, and CD-based instructional materials, because of the following advantages :

- Low cost of production
- Computer platform independence
- Multimedia capabilities
- Easy to update
- Time independence
- Global reachability through Internet

A *Web-based study guide* (or *Web study guide*, for short) is a kind of Web hyperdocument whose purpose is to communicate teaching about a subject to a group of distance learners. Four important elements of a Web study guide are its structure, its user interface, its content and the teaching-learning process. The structure is made of a set of Web pages interconnected by hyperlinks and distributed over Intranet or Internet. The content refers to the subject of the course, its organization in themes and the information used by the teaching-learning process. The user interface is concerned with the sensorial and aesthetic properties of the study guide.

The use of the Web technology imposes specific requirements to the process of developing a Web study guide. These requirements cannot be satisfied with the existing methods for developing conventional or print-based study guides, such as those described in [1]. On the other hand, the existing methodologies for developing hypermedia applications or hyperdocuments are very general [2,3,4,5,6]. As a consequence, they do not take into consideration neither the course content nor the teaching-learning process to be used, which are two essential elements of a study guide. To the best of our knowledge, no method has been published yet concerning the design and development of Web study guides for distance education courses.

In this paper, we describe a method for guiding a team during the process of developing a Web study guide. This method takes into consideration the aforementioned elements of a Web study guide: structure, user interface, content and teaching-learning process. The design of the method was based on the integration of principles and process models used in Object-Oriented Software Engineering and Instructional Design. The process model of the Instructional Systems

Design - ISD - [7] was used as a framework for designing our method. It was combined with an object-oriented process model for hypermedia applications [8]. The method makes use of the notations of the Object Modeling Technique - OMT [9] - for designing the structure and behavior of a study guide.

The paper is organized as follows. Section 2 describes the components of a Web hyperdocument by using an object-oriented model. This model is then applied in Section 3 for designing a generic structure that can be used as a reference model for organizing a Web study guide. The structure of the method, its phases and steps, and the organization of the development team are explained in Section 4. The concluding remarks are given in Section 5.

2.- An object-oriented model of a Web hyperdocument

World Wide Web is a technology that emerged from the integration of Internet and Hypermedia. It is defined as “a wide-area hypermedia information retrieval initiative aiming to give universal access to a large universe of documents” [10]. It is a technology for sharing multimedia information between a globally distributed community.

From the user’s point of view, Web is a global, computer platform independent, multimedia and client-server system. Users may access Web hyperdocuments from anywhere, anytime, and using any computer platform.

The structural components of a Web hyperdocument may be represented, in terms of the OMT notation, as shown in Figure 1.

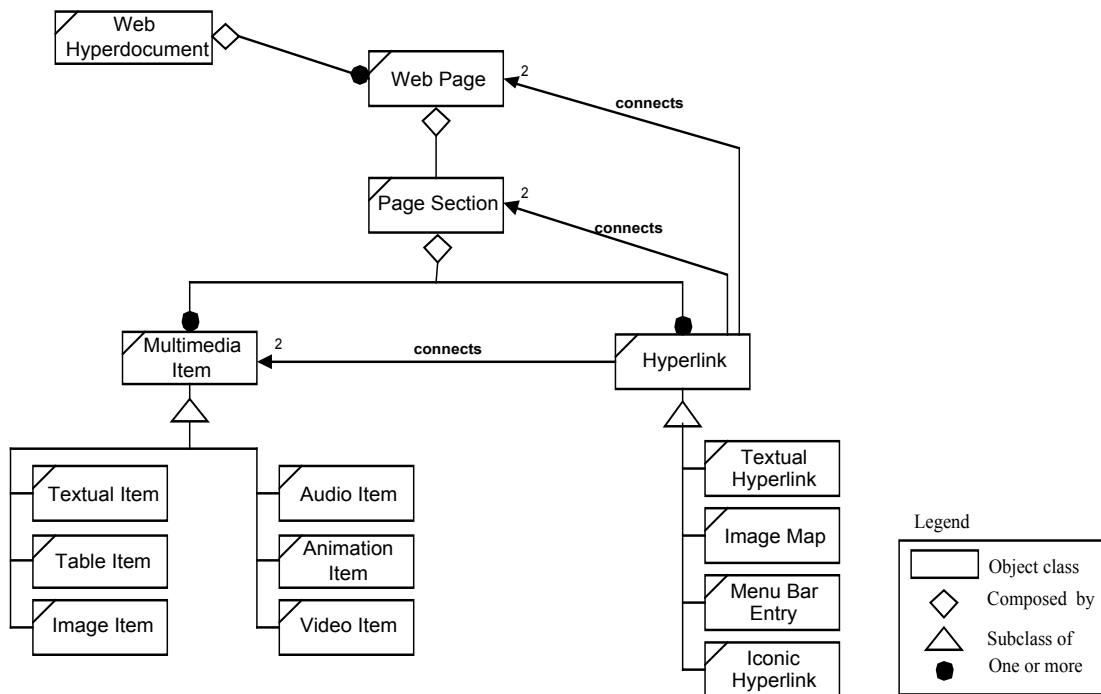


Figure 1. An object model of a Web hyperdocument

According to this model, a Web hyperdocument is composed by a set of Web pages. Each Web page may be organized into one or more page sections. A page section contains one or more multimedia items or data of the following types : text, tables, graphics, images, audio, animation and video. Web pages, page sections and/or multimedia items are connected by hyperlinks. A hyperlink establishes a association between two Web objects. i.e., two pages, two page section, two multimedia item or any combination of two of them.

The Web technology is based on a client-server architecture. Web pages and multimedia Web objects such as audio, video and image files are stored on a computer called *server*. Another computer called *client* may request the web object stored on the server. This is done through an identification mechanism called Uniform Resource Locator (URL) which is used by the client to retrieve a Web object from the server. The requested object is brought through Internet or Intranet and displayed on the client using a Web browser.

A Web browser is a program that visualizes Web pages and images. It may also activate other web applications, including Java applets, video and audio clips, and Internet services, such as E-mail, News and desktop videoconferences. A Web browser gives the user the navigation facilities needed for moving from the actually displayed page to another Web object. Navigation is done by activating a hyperlink, that is, by pressing its associated button on the page displayed by the browser.

3.- Web-based study guides

Based on the outline of a typical study guide given in Section 1, we designed an object-oriented model that captures the generic structure of a study guide (see Figure 2). This model represents the main classes of objects of a Web study guide and indicates their composite relationships in terms of the OMT notation.

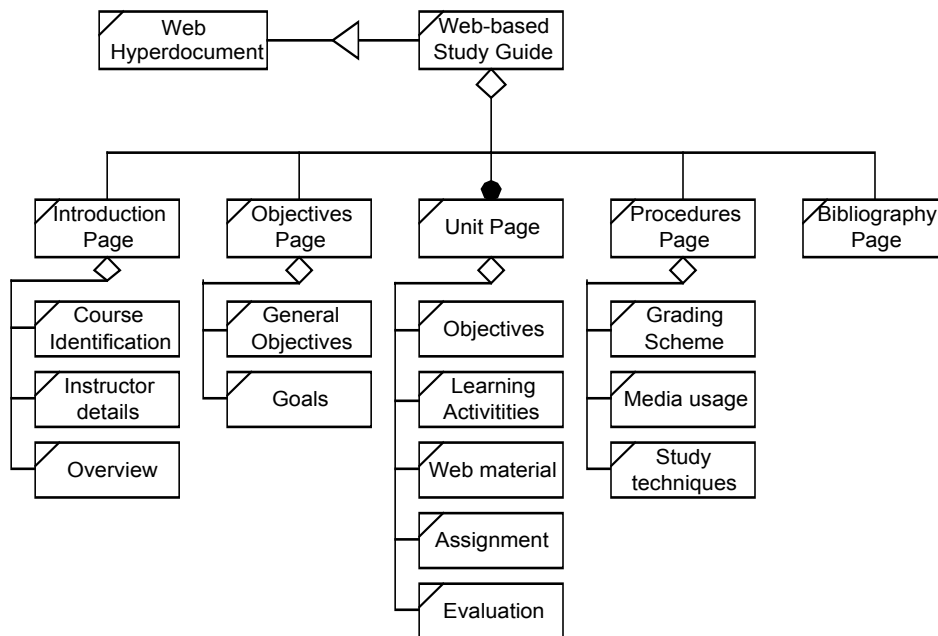


Figure 2. Structure of a typical Web-based Study Guide

A Web study guide is composed by a set of Web pages that : (a) provides an introduction to the course, (b) describes its general objectives and goals, (c) contains a set of units that links to other instructional material (including Web hyperdocuments), and (d) describes the procedures and the bibliography to be used in the course. Each Web page is, in turn, divided into page sections, as indicated by Figure 2.

The core of a Web study guide is made of lessons or units. A unit contains information to be read by the student, as well as a description of other activities to be performed, such as associated readings, written assignments, other media to be used and self-testing questions or other forms of evaluation.

We have only addressed, in this section, the structure of a study guide. The design of a Web study guide is, however, a more complex process that involves not only the design of an structure, but the design of a content, an user interface and a teaching-learning process. In the next section, we introduce a novel method for developing Web study guides that considers these four aspects of a study guide.

4.- The Object-Oriented Method for Developing Web Study Guides

4.1.- The structure of the method

The method proposed in this section is the result of integrating two process models : the Instructional Systems Design [7] and an object-oriented method for developing hyperdocuments [8]. Many principles, techniques and concepts from the Object-Oriented Software Engineering discipline were also considered and used in the design of the method.

The method is composed by six phases, as shown in Figure 3. It covers the complete life cycle of a Web study guide : from the analysis of its domain to its delivery. It should be noted that the evaluation (Verification and Validation) phase is at the center of the cycle. It means that the evaluation of results starts from the very beginning of the development process, instead of being executed at the end as it is proposed by the ISD model. Two advantages of this feature are the following : (1) a better quality assurance of the product is achieved and (2) a better change control of requirements and design specifications are executed during the whole process.

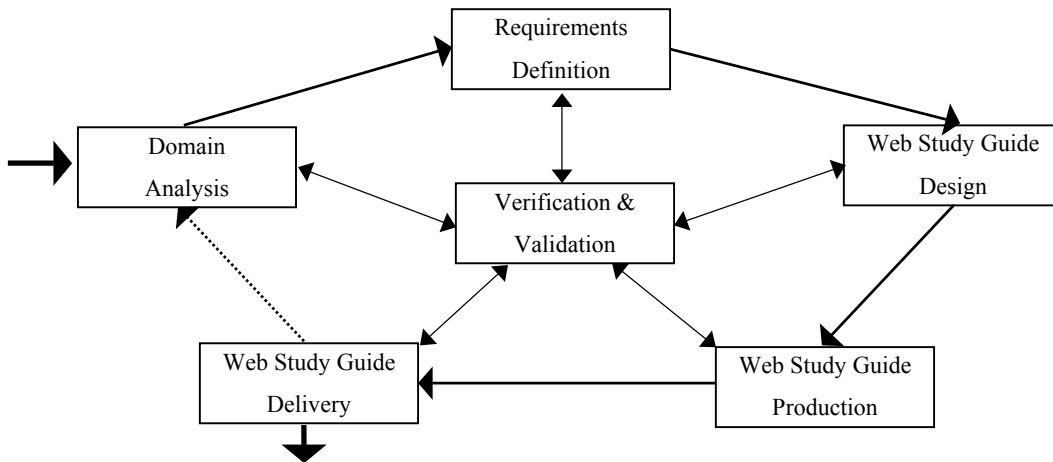


Figure 3. The phases of the method

4.2.- The development team

Two types of team organization has been applied to the development of study guides for distance learning courses. The first of them, called the Author-Editor Model, is the simplest one. In this model, a content expert or the instructor of the course designs and writes the content and an editor produces the final document. In the second model, called the Course-Team Model, a course is designed by a team of many people (20 or more), each of whom is a specialist in the course content or in the different media technologies being used [1].

We believe that an intermediate model is more appropriate to the development of Web study guides. A team integrated by a webmaster, a content expert (e.g., the course instructor), a graphics designer, and an audiovisual expert may be sufficient for developing a Web study guide of medium size (say less than 300 pages). Obviously, the size and

composition of the development team depends on other factors different than the scope of the study guide, such as the budget assigned to the project, the time restrictions, and the availability of experts.

4.3.- Phases and steps of the method

4.3.1.- Phase 1 : Course Domain Analysis

Before designing a Web study guide, an analysis of the course domain is required in order to understand its nature, components and environment. Aspects of this domain that should be taken into account are directly related to the main entities of the teaching-learning process : the content, the student, the instructor, and the learning environment [11].

Step 1.1 : Analyzing the content variables .- This step involves the identification and analysis of the subject of the course, the documentation and search of relevant bibliography on the subject, the definition of the course content, the organization of this content in themes, and the definition of the objectives and goals of the course.

Step 1.2 : Analyzing the student variables .- The main variables to be considered about the student are the knowledge, skills and abilities to be learned ; prior knowledge on the subject ; skills required before taking the course ; students profile ; and student's motivation to take the course. Outlining the students profile consists on estimating the general or average abilities of the students for : using the computer (computer proficiency), following a distance learning course, and doing independent study.

Step 1.3 : Analyzing the instructor variables .- Some of the most important variables to be considered when analyzing the instructor entity are the following : subject-matter knowledge, distance teaching experience and attitude, computer proficiency, knowledge and experience on Internet services (WWW, FTP, E-Mail, News, etc.), and pedagogical profile of the instructor.

Step 1.4 : Analyzing the learning environment variable .- The learning environment refers to the location of the students, the telecommunication technologies and the hardware-software platform that they will have available at their learning sites, the social and physical environment, and the time availability of the students for following the course.

4.3.2.- Phase 2 : Requirements Definition

Requirements are concerned with the functional and technical attributes that should be satisfied by the Web study guide. Costs, time and resource limitations for developing and using the Web study guide are also considered as requirements. Defining and specifying requirements are needed for two purposes : (1) to guide the development team about the most important features to be considered during the design phase ; and (2) to verify and validate the study guide once it has been designed and produced.

Step 2.1 : Defining the learning requirements .- The learning activities that the students should perform are defined in this step. Reading, writing, viewing, listening, group interaction, and testing are kinds of learning activities. The length of the course in weeks and the number of study hours that the student should devote to the course are also estimated here. The content should be distributed over the length of the course in a weekly basis, in order to produce the timetable of the course.

Step 2.2 : Specifying interaction requirements .- Interaction is concerned with the way the student interacts with the Web study guide and the teaching-learning environment. Web browsers provides a uniform and common graphical user interface. However, details of the interface should be specified in order to accommodate the learning activities defined in the previous step (2.1). Examples of interaction requirements are the following :

- The types of interaction to be supported by the study guide.- Three types of interaction are essential in distance education course: student-content, student-instructor, and student-student.
- Others media to be used together with the Web study guide.- The hyperlinking capability of a Web document makes a study guide an excellent vehicle for integrating different media. For example, a Web page may contain buttons that link that page to other media, such as a desktop videoconference, file transfer, e-mail, and digital libraries.

Step 2.3 : Determining the development and operational requirements .- The development and maintenance a Web study guide depend upon the availability of limited resources, such as time, hardware, software, people and financial support. The design of a Web study guide is partly determined by the amount of resources available to the development and maintenance teams. A Web server and Web development tools (e.g., Web editors, image processing tools, graphic editors, audio and video editors) should be available to develop and use a Web study guide. The purpose of this step is, therefore, to estimate the time and cost of developing a Web study guide and to negotiate with the course sponsor the time and cost of the project.

Step 2.4 : Specifying quality attributes .- The quality of a Web study guide is as important as its content. Achieving quality requires a commitment to well established Web style rules and design criteria. Quality is measured based on a set of predefined attributes. The values of these attributes must be specified in this step. Quality attributes can be divided as follows :

Structural attributes : The structure of a Web study guide must be modular, visible, well balanced, easy to modify and easy to navigate. A modular study guide helps the user to navigate smoothly through its content. Modularity also simplifies the process of updating and modifying the content of a study guide. It is achieved by dividing the structure of a Web study guide into a set of hierarchical cohesive pages based on content (e.g., thematic chapters, sections and subsections). Visibility, on the other hand, is concerned with helping the student to see the study guide structure. Index pages and tables of contents can show clearly the structure of the study guide. Orientation is also needed to avoid getting lost in the hyperspace defined by the study guide. Navigation aids such as navigation bars that link to “previous”, “next”, “home”, “table of contents”, and “index” pages should be included at the bottom or top of each page. Other tools for navigation are frames, drop-down menus, image maps, and site maps [12].

Interface attributes : Students interact with the course content through the Web pages of the study guide. These pages may contain many hyperlinks and different types of multimedia items o data, including text, tables, still images or photographs, animations, video and audio clips. How these hyperlinks and data are organized into the pages and visualized on the screen is a crucial factor for the successful design of the study guide. Specific attributes of the interface are the following : page length, background color and texture, design grids, size and resolution of graphics and images, and typographic design. Many conventional document design principles can

also be applied to the design of Web pages, as suggested by the Web Style Manual of the Yale Center for Advanced Instructional Media [13].

Content attributes : Some of the aspects that must be addressed about the content are, for example, the scope of the content, the logical sequence and organization of the content, its completeness, the way of stimulating or motivating the student, the feedback on assignments, the methods used for evaluating the content, and the repetition and summary of the most important ideas [1].

Step 2.5 : Verifying the requirements .- This phase concludes with a verification of the requirements based on the domain analysis and an estimation of the economical, technical and psychosocial feasibility of each requirement.

4.3.3.- Phase 3 : Web Study Guide Design

Designing the web study guide is the most complex and time consuming phase. We have focussed the attention on the design of the structural, navigational, conceptual and sensorial aspects of a Web study guide, because they have proved to be decisive factors of the quality of a Web hyperdocument [12].

Step 3.1 : Designing the study guide structure .- Figure 2 illustrates a typical structure of a Web study guide. The main Web page of a study guide is the Introduction Page. This page identifies the course and its instructor(s) and gives an overview of its content. It includes an index or table of content of the main Web pages of the study guide, as shown by the navigational graph in Figure 4. This structure may be changed to accommodate particular requirements specified in the previous phase.

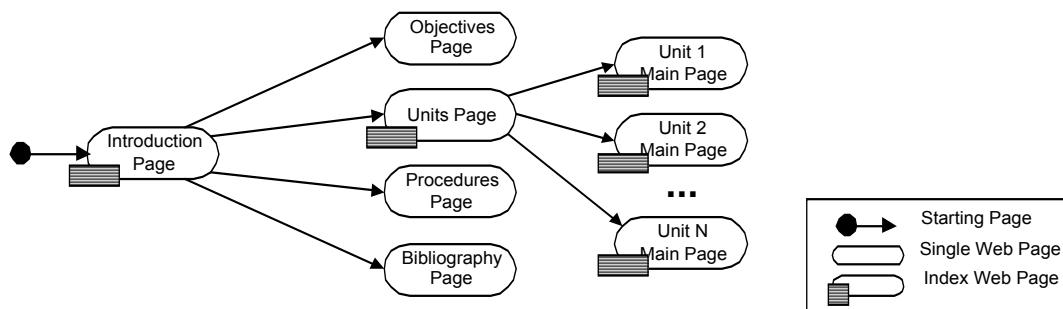


Figure 4. Navigational graph of a Web study guide

The content of a course must be divided into a sequence of units, lessons or themes based on a given criteria, such as : (a) the conventional structure of the subject, as exhibited by the main textbook used by the course; or (b) an uniform time distribution of the learning activities over the duration of the course.

Step 3.2 : Designing the units or lessons .- Each unit of a study guide covers a specific content and has associated one or more instructional objectives. To accomplish these objectives, the development team must define a set of learning activities to be done by the student according to a given schedule. The most common activities are the following : reading the bibliographic material, navigating through the Web material, writing assignments, listening and viewing a video or a videoconference, answering a test, and participating in a discussion group by using e-mail, News or any other collaborative work tool.

Once that the objectives and specific contents of each unit has been defined, its design must proceed as follows :

Step 3.2.1 : Designing the structure of each unit .- This structure is also hierarchical. Its root, called the Main Page of the unit, contains the following information :

- an identification of the unit including its duration and timetable,
- the objectives of the unit,
- its specific contents,
- methods or techniques to be used for evaluating the student and the evaluation timetable, and
- an index for the learning activities to be performed by the student in that unit (see Fig. 5b).

The learning activities of a unit may be organized into a set of coherent and complementary learning activities, as shown in Figure 5a. Each activity has a specific purpose and applies a particular media and technology.

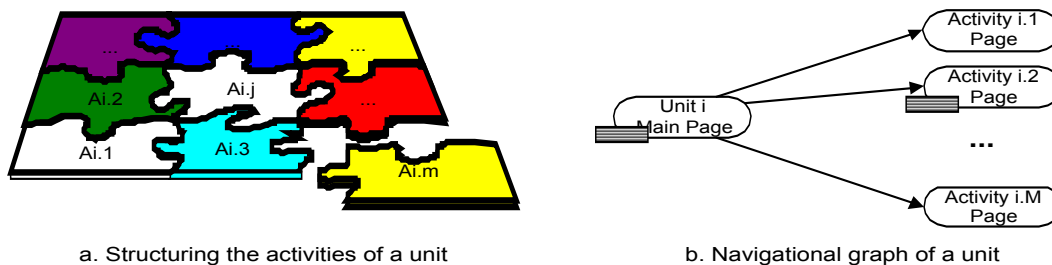


Figure 5. Structure of a unit

Step 3.2.2 : Linking the learning activities .- The Main Page of a unit must provide the hyperlinks needed to guide the student through each activity, as shown in Figure 5b. An activity page describes a learning activity to be developed by the student. It may contain the appropriate hyperlinks to the media that will be used by the student. For instance, if the activity involves the use of remote Web hyperdocuments then its associated page will include hyperlinks to request their Web pages. Desktop videoconference sessions, digital videos, e-mail, collaborative work tools and any other Internet facility may also be invoked from an activity page using hyperlinks.

Step 3.3 : Designing the Web pages .- Once that the structure of the web study guide has been designed, the development team may determine the structural, style and content details of each page. The details may be defined through the following sub-steps :

Step 3.3.1.- Modeling the structure and behavior of each page .- A Web page is composed by a set of multimedia items or data (i.e., text, graphics, still images, animation, and video), and a set of buttons that display the hyperlinking capability of the page. A button may be associated with a textual, graphical or image item. When a button is pressed, it signals the Web browser to activate the associated hyperlink which allows the user to navigate from the actually displayed page to other local or remotely stored Web page or multimedia item.

The structure of a Web page indicates the location of its items and buttons on the rectangular area or space it occupies, as shown in Figure 6a. The behavior of a page is concerned with transformations or state changes that its hyperlinks cause on the Web browser when they are activated. These changes may be represented using the dynamic modeling notation of OMT [9]. Figure 6b exemplifies a state diagram that shows the navigational effect caused by pressing the different buttons of the page given in Figure 6a.

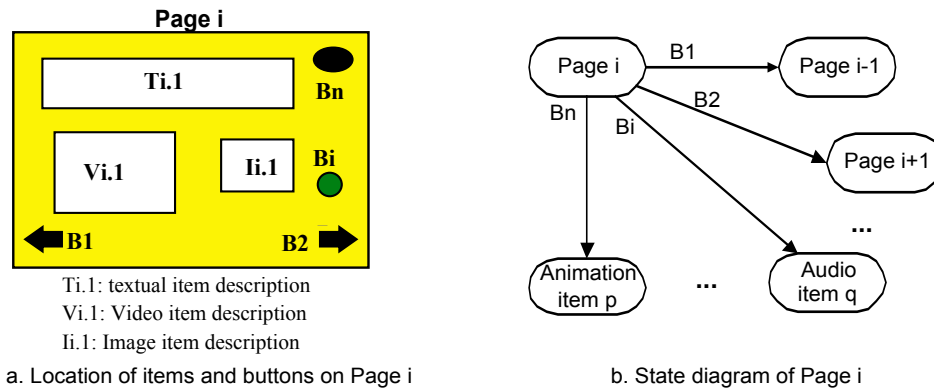


Figure 6. Structure and behavior of a Web page

Many navigational aids, such as index frames, navigation bars, menus, and site maps, are common to most of the pages of a Web hyperdocument. Therefore, this step may be simplified if we use a standard page design for all pages of the Web study guide. This page layout should comprise the navigational aids, the page background, the logos, and the page titles that will be shown on all pages.

Step 3.3.2.- Designing the items of each page .- All the multimedia items to be included in the different pages of the study guide must be designed in this step. The content, art and visual details of each multimedia item should be outlined here depending on its type. For instance, the design of a textual item requires to give an outline of its content and its typographic properties (e.g., font, size, color and style). For a video item, the development team must specify its content, size, duration and resolution. An image item design involves the definition of its content, size, resolution and art details.

Step 3.4 : Building a prototype of the Web study guide .- Based on the design specifications produced in the previous steps, the development team can now build a prototype of the Web study guide. This prototype may be constructed using a good Web editor. It may be seen as a skeleton or framework that shows the structure of the study guide, as well as all the hyperlinks and navigational aids that are included in each page. The purpose of the prototype is dual. Firstly, it will be used in the next step for verifying and validating the design. Secondly, it will be employed as a framework for assembling the different items that are produced in Phase 4. The prototype will evolve into a finished product through the assembling of the multimedia items and its verification and validation, as indicated in the next step and phases.

Step 3.5 : Verifying and validating the design .- The design of the study guide must now be verified and validated using its prototype. Verification involves the use of the requirements specified in Phase 2. The development team must confirm that all the requirements are satisfied by the prototype. If this is not the case, the team must modify and adjust the prototype to include those requirements that were ignored or have appeared during the design phase. Validating the design requires an interaction with the prototype. Selected students or users must interact with the prototype in order to identify missing or undesirable characteristics and improper linking. The aesthetic quality of the prototype should also be evaluated by these students.

4.3.4.- Phase 4 : Web Study Guide Production

The production of the Web study guide is concerned with the elaboration of the items that were designed in Phase 3 and its assembling into the prototype.

Step 4.1 : Producing the multimedia items .- This step requires the assistance or participation of specialists in audio-visual technologies. Producing an animation or video clip, for instance, is a very complex and creative process for which special skills and abilities are required. Experts are, therefore, needed for producing the animation, image, audio and video items. Similarly, the content of the textual items must be written by the content expert.

Step 4.2 : Assembling the items .- The produced items can now be assembled into the prototype. Textual and table items can be added to the prototype using directly the Web editor. Image, audio, animation and video items may require additional processing before being integrated to the prototype. Digitalization, edition, storage and format conversion are some of these processing activities that have to be executed by the development team. At this point, the Web study guide has evolved from a prototype to a semifinished product, which is ready to be evaluated.

Step 4.3 : Verifying and validating the Web study guide .- A final evaluation of the Web study guide can now be conducted. An updated set of requirements are used for verifying the study guide. Each requirement is contrasted with the study guide to determine its fulfillment. The results of this process are used for adjusting and refining the study guide. Then, a group of students is selected to perform the final validation of the product. These students interact with the study guide by simulating the learning environment. New requirements, shortcoming and errors may arise in the validation process. A quick iteration of the specification, design and production processes may be needed to incorporate the final changes before delivering the product.

4.3.5.- Phase 5 : Study Guide Delivery

Finally, the Web study guide is taken to its operational mode. It is stored on the Web server from which it will be accessed by the remote students using a Web browser. This step signals the end of the development process and indicates the beginning of the maintenance stage of the Web study guide.

5.- Conclusion

We have presented in this paper a novel method for dealing with the process of developing Web-based study guides for distance education courses. One of the most important features of the method is its emphasis on the quality of the product, which is assured by the use of well known principles, techniques and methodological concepts borrowed from the Object-Oriented Software Engineering and Instructional Design disciplines.

Our method differs from those used in developing hyperdocuments and study guides in several respects. First, our method is specific to Web study guides - a particular kind of Web hyperdocument. It, therefore, addresses particular problems and elements of this type of hyperdocument. Second, our method covers the whole life cycle of a Web study guide ; whereas most of the hypermedia methods concentrates on the design of hyperdocuments [4,5,6]. Third, instead of evaluating the product at the end (as in the ISD model [7]), we make use of the verification and validation process as a continuous activity that have to be performed through all phases of the method.

The method is actually being used for developing courses of a distance education postgraduate program in Computer Science at the University of Los Andes in Venezuela [14].

References

- [1] M.G. Moore and G. Kearsley, *Distance Education : A Systems View*, (Belmont, California, Wadsworth Publishing Company, 1996).
- [2] M.J. Bunzel, *Multimedia Applications Development Using DVI Technology*. (New York, McGraw Hill, 1990).
- [3] J. Martin, *Hyperdocuments and how to create them*. (Englewood Cliffs, New Jersey, Prentice-Hall, 1990).
- [4] F. Garzotto, P. Paolini, and D. Schwabe, "HDM - A Model Based Approach to Hypermedia Application Design", *ACM Transactions on Office Information System*, 11 (1), 1993, p. 1-26.
- [5] F. Garzotto, L. Mainetti, and P. Paolini, "Hypermedia Design, Analysis, and Evaluation Issues", *Communications of the ACM*, 38 (8), 1995, p. 74-86.
- [6] J. Nanard and M. Nanard, "Hypertext Design Environments and the Hypertext Design Process", *Communications of the ACM*, 38 (8), 1995, p. 49-56.
- [7] W. Dick and L. Carey, *The Systematic Design of Instruction*, (Glenview, IL, Scott, Foresman & Co., 1885).
- [8] J.A. Montilva, "Applying software process models to the development of hypermedia applications" (in Spanish), *Proc. of the XXII Latin-American Conference on Informatics (PANEL '96)*, Vol.2, 1996, p. 870-881.
- [9] J. Rumbaugh, et al. *Object-Oriented Modeling and Design*. (Englewood Cliffs, New Jersey, Prentice Hall International, 1991).
- [10] G. Ritzenthaler and D.H. Ostroff. "The Web and Corporate Communication : Potential and Pitfalls". *IEEE Trans. On Professional Communication*. Vol. 39, No. 1, March, 1996, pp. 16-22.
- [11] R. Dean., P. Biner, and M. Coenen, "Distance Education Effectiveness : A System Approach to Assessing the Effectiveness of Distance Education", *Education at Distance Journal*. 10 (3), 1996, p. J1-J4.
- [12] WDWL, *Web Developer Virtual Library*, (<http://WWW.WDWL.com>).
- [13] P. J. Lynch, "Web Style Manual", Yale Center for Advanced Instructional Media, (<http://info.med.yale.edu/caim/stylemanual/>).
- [14] B. Sandia, D. Hernández, J. Montilva, E. Pabón, F. Pedroza, and C. Morales, "Designing an Interactive Distance Learning Program for Computer Science", *Proc. of World Multiconference on Systemics, Cybernetics and Informatics (SCI'97)*, Vol. 2, Educational Systems Session, 1997, p. 190-197.