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Developing Web Based Learning Environment Using Web Instructional Design Model

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Abstract: Due to the technological advancement and phenomenal development in all the fields of education, research, inventions, innovations there is a rapid growth in web based information society. Software products developed using software process models have become successful as they adopt standard software engineering methodology. But today's Information technology product development is undergoing a rapid shift that prevents applying traditional software engineering methodology to web engineering methodology since most of the applications are web based. Through internet is becoming the world wide class room, the accessibility to information becomes reality at any point of time. Web-Based Learning Environment (WBLE) becomes a crucial resource for learners and educational institutions. Web-based learning environment must take into consideration that education has triggered a shift from the teacher-centered paradigm to the learning-centered paradigm. For developing the software products we have solid endorsed process model, but we still struggle to build and maintain large complex web sites and applications because web developers don't have a disciplined development process and sound methodology. Many factors has to be considered when we get into the Web Based Development, endorsed framework where the content can be easily updated and changed, maintainability, scalability, user interface, pedagogical aspects, ethical issues, media elements. The construction of Web applications has made a lot of improvements, but there is a lack of a disciplined engineering approach for building Web-based systems. To successfully develop a large Web System we need a team of people with wide ranging knowledge and skills. Most of the development of Web-based learning environment is developed without a complete understanding of requirements that are proper to Web-based learning. This results in dreadful analysis, design, poor quality, pedagogical and maintainability. The applications become increasingly complex and the development process still remains ad-hoc. Many organizations and developers have successfully developed large, high-performance Web sites and applications, but others have failed or are facing the possibility of major failures. A survey on Web-based application development by the Cutter Consortium highlights the problems plaguing large Web-based projects: 84% of the time delivered systems didn't meet business needs, 53% of the time delivered systems didn't have the required functionality, 79% of the time schedule delays plagued the projects, 63% of the time projects exceeded the budget. The primary causes of web system failure are a flawed design and development process, and poor management of development efforts. All these have been recognized to be one of the main reasons for the low acceptance of disciplined development in the Web. As a result, Web engineering is still struggling to establish itself as a reliable engineering discipline. However it lacks two important considerations for developing Web Based Learning Environment (i) Systematic iterative process model has to be identified for sound disciplined methodology to maintain large complex web based information system (ii) Since content are embedded in an online learning environment, to Identify pedagogical model framework where learning process should be an on going process, effective and collaborative, thinking capability, to construct skills and knowledge on their own, active learning, student motivation and needs.

Based on many years of research, all the above issues have considered exploring a sound systematic approach to maintain large complex Web Based Information Systems and practices and presents multidisciplinary perspectives that help shape this dynamic area of Internet and Web application development.

I. RATIONALE

The growth of Web based Information system has a significant impact on industry, education, business, government and in personal and working environment. The internet is most widely and accepted information system where we access whatever information we need from anywhere at any point of time. The popularity and ubiquity stems from the nature of the web itself and its features: it provides an information representation that supports interlinking of all kinds of content, easy access for end users, and easy content creation using widely available tools (**San Murugesan, Yogesh Deshpande, Steve Hansen and Athula Ginige)**. So product development is undergoing a paradigm shift from applying traditional software engineering methodology to web engineering methodology.

The real value of Web-based learning is to help students acquire knowledge in order to function as active, self-reflected and collaborative participants in the information society. These experiences made us to explore a sound iterative systematic way to develop large and maintainable web based information systems and to identify the pedagogical framework since the information are embedded in the online environment.

II. INTRODUCTION

There is a need for an iterative process model to follow while developing a large Web based information system. This iterative process consists of a set of manageable activities that are needed to be carried out to develop the web site and then to keep its information up to date. Also, from time to time, we need to add new functionality and information resources (Athula Ginige). Sometimes the information in the subject has to update or changed for every six or the entire course content, this has to be properly maintained by an expert. In certain instance the entire web site has to be redesigned.

Moreover, web-based applications run in a heterogeneous computing environment that includes components and multimedia support. This environment has languages and technologies, such as Java, HTML, Javascript, Web servers and databases, Microsoft front page, Macromedia Dreamweaver etc that provide support for the development of web-based applications. The important aspect is to select the appropriate components to create the interactive web based

learning environment to maintain information and complexity of the Web site, skills and knowledge acquired by the students, conceptualization and re-conceptualization technique. These components then need to be arranged in a logical architecture. In addition to this, the construction of web-based system is affected by engineering issues, eg. process models, hypertext and hypermedia, multimedia components, usability engineering, accessibility engineering, guidelines for web design, reuse components, design patterns, architectural frameworks. The choice of a process model depends on many factors. Some of these are, the scale of the application, the nature of the information, frequency at which information needs to be changed or added, experience of the development team and clients of developing similar systems, computer literacy level of the users, available time to develop the application and the budget.

Several attributes of quality for developing Web Based Learning Environment has to be considered for the learners and educational institutions such as usability, navigation, accessibility, scalability, maintainability and interoperability.

A web site is created using different components HTML, XML, Java script, Adobe Flash, Adobe Flex etc., and appropriate tools are used to create a high quality intreactive web based environment. Different experts from different disciplines are needed like subject expert, instructional designer, programmer, animator, web developers, database experts etc., to shape the web environment to be flexible, ease of use and dynamic in nature.

All these factors are consider to explore a systematic iterative process model, sound disciplined methodology to maintain large complex web based information system and to Identify pedagogical model framework where learning process should be a continuous process.

The Web-based learning environment is identified and developed for the subjects in the MCA curriculum, which comes under Anna University of Technology, Coimbatore (India).

III. APPROACHES FOR DEVELOPING WEB-BASED LEARNING

A. Pedagogical Foundation

Pedagogy embodies knowledge and skills, classroom management, and overall effective teaching practices. It is a complex blend of professional knowledge and practitioner skills. A teacher's own pedagogical beliefs and values play an important role in shaping Web-based learning environment. Research has shown that the appropriate use of learning theories can catalyze the paradigmatic shift in both content and pedagogy which is the heart of any educational reform in the 21st century. If designed and implemented properly, especially computers and internet technologies can promote the acquisition of knowledge and skills that will empower students for lifelong learning. These new ways of teaching and learning are underpinned by constructivist theories of learning and constitute a shift from a teacher-centered pedagogy to one that is learner-centered.

Literature reviews suggest that theories can be related to three main commonly accepted paradigms: Behaviorism, cognitive constructivism, and social constructivism (Gros, 2002; Phye, 1997; Piaget, 1969; Skinner, 1976; Steffe & Gale, 1995; Vygotsky, 1978; Wilson, 1998).

Behaviorism

The goal of instructions in behaviorism model assumes that the learning is to efficiently transmit knowledge from the instructor to the learners. Learning is seen as largely as a passive process. In a behaviorist setting, instructors are clearly central to learning activities. Students are passive recipients of knowledge, rather than constructing their own knowledge. The behaviorism promotes stability and certainty with respect to knowledge transmission, there are a few opportunities for learners to express their own ideas, because behaviorism teaching does not engage the mind appropriately to go beyond prior knowledge.

Cognitive Constructivism

The cognitive constructivism is the product of passive transmission of active construction. It is a framework where learners can acquire knowledge from the environment and can construct their own knowledge based on their prior knowledge and experience. The knowledge construction process requires cognitive skills, such analysis and reasoning skills, meta-cognitive skills, such as reflection and self-evaluation, and analogical thinking. In addition, Constructivist learning theory paves the way to a multi-dimensional view of communication. Constructivist practice facilitates reciprocal communication and a more balanced participation between educational participants. Using this approach, teachers can employ collaborative learning techniques that allow students to combine efforts at solving a problem, or in task management. In this constructivist approach, teachers become guides rather than dispensers of knowledge and helps to create learner-centered environment that promote active, independent and self-reflected knowledge construction (Said Hadjerrouit, 2006).

Social Constructivism

Social constructivism focuses on groups and their learning within socio-cultural contexts. Vygotsky argued that the way learners construct knowledge, think, reason and reflect on is uniquely shaped by their relationships with others. Accordingly**,** learning emerges through interaction of learners with other people, e.g. instructors, fellow learners. Learning occurs as learners exercise, test, and improve their knowledge through discussion, dialogue, collaboration, and information sharing. This means that knowledge is created as it is shared, and the more it is shared, the more it is learned.

B. Web-Based Learning Development Approaches: State of Research

The development of Web-based learning environment lacks the type of specific methodology as clearly indicated by researchers. Authoring tools are used to produce and document Web-based learning and monitor some activities but they do not form the integrated tools for the development process (Standing, 2002). Web-based learning environment are entirely different from the software development because the contents are embedded in the online environment and it should mainly focus on scalability, maintainability, learning theories, skills and knowledge, cultural and social issues. Web-based systems evolve from static, content-driven applications to dynamic interactive and ever-changing ones. Hence there is a need to identify systematic iterative process model for the development process and maintenance.

Approaches that use conventional software engineering models are not suitable for developing web–based learning environment. Table 1. given below describes the potential deficiency of conventional software engineering models.

Table 1: Deficiency of conventional software engineering models

S.No	Existing models	Deficiencies
1	Waterfall model	Lacks flexibility for adoption.
2	Spiral model	More complicated for adoption.
3	Prototype model	Time consuming.

More specifically, most course Web sites provide little support to achieve flexibility and learner-centered instruction, because they are static and rarely updated and maintained, diminishing the indisputable character of the Web (Lazarinis, 2004; Kirshner & Paas, 2001). The primary cause of web system failure is a flaw between design models and the implementation model, implementation model and maintenance of the web which is recognized as one of the main reasons for the low acceptance of disciplined development in the Web, since as a result, Web engineering is still struggling to establish itself as a reliable engineering discipline. Hence a strong iterative process model is needed to fill the gap from the design stage to maintenance because learning is a continuous process and upto date information has to be updated.

IV. PROPOSED PEDAGOGICAL MODEL

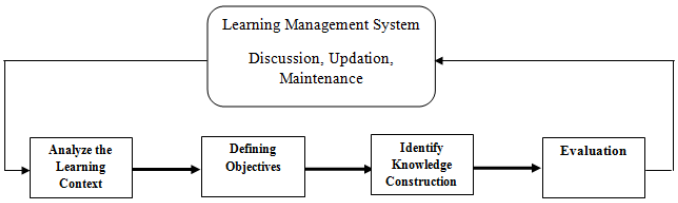

Figure 1: Pedagogical Model

Constructivism is a theory of learning, not a description of instructional techniques. A pedagogical model is a conceptual construct that can be used by teachers as a framework for instruction using a specific learning theory (Nunes & McPherson, 2003). Thus, the starting point for developing a pedagogical model is the constructivist learning theory and research work related to the design of constructivist learning environments (Bradley & Oliver, 2002; Duffy, Lowyck, & Jonassen, 1993; Gros, 2002; Hirimi, 2002; Honebein, 1998; Honebein, Duffy, & Fishman 1993; Wilson, 1993).

This pedagogical model encompasses a learning management process and many learning phases. The goal of learning management process is to enable instructors to monitor the entire learning process through providing feedback, e-mail, communicating, asking students, etc. The learning phases are an orderly set of interdependent learning activities moving from context analysis to the communication of learning results. The model consists of five phases as shown in Figure 1.

Managing the Learning process occurs throughout the whole learning process. As learning shifts from the "teacher-centered model" to a "learner-centered model", the teacher will be supplementary to the students and acts as a "guide by the side". The teacher's primary task becomes to teach the students how to ask questions and pose problems, formulate hypotheses, locate information and then critically assess the information, found in relation to the problems posed. This process refers also to the fact that a group of students work together and collaborate on a task.

Analyzing the Learning Context is a process of gathering data from the real environment. The structure of a course determines the flow of instruction through pre determined instructional events. The course map is like a plan for the sequence of instruction. To develop the course map, the instructional designer reviews the source materials, interviews subject matter experts, and examines the learner analysis, tasks and objectives, learners, pedagogy, technology, and organizational and institutional climate.

Objectives provide a focus to the learner and the course development team by stating the intended result of the course and the expected outcome for the learner. They describe learner performance in terms of what the learner will be able to accomplish at the end of the course.

To analyze students prerequisite knowledge and skills involve talking to and gathering information from a range of people such as potential learners, IT professionals etc., To gather information from them, data collection methods such as questionnaires, interviews and observations are used. The purpose of learner analysis is to determine the current ability level of the learners to identify learner characteristics and make decisions about how to teach effectively so that the course is designed to meet the learner's needs.

Evaluation involves measuring learner's skills, knowledge, and behavior to verify that they are at the expected proficiency level at the end of the course. The ultimate aim of evaluation is to collect valid, relevant and reliable information about the learner and make informed decisions. Evaluation is performed using test items. The purpose of test items is to (i) Provide an opportunity for interaction (ii) Check and reinforce learning intermittently (iii) Check for mastery at the end of the course.

Assessment can be done in three stages (i) Formative evaluation is conducted at several points during the development of the course to improve the course (ii) Summative evaluation is conducted at the end of the course to measure the degree to which the course has achieved its objectives (iii) Confirmative evaluation is conducted a few months after the course completion to assess learners retention of knowledge and skills over a period of time.

V. PROPOSED WEB ENGINEERING PROCESS MODEL

Web-based learning environment needs a disciplined, iterative systematic approach, which focuses on content, learning theories, instructional design, reusability, hypermedia, scalability, maintainability, technical and non-technical aspects and deliver the system as quickly as possible. This is not a shifting process from traditional software development but embedded in the on-line environment, so proper attention and iterative process has to be done between the requirements and design phases, design and implementation phases, implementation phases and maintenance.

As a result, web-based learning needs a unique process model and some aspects can be incorporated from other existing process model. Firstly, iteration and structured process model has to be identified which deals with change and evolution. Secondly, reuse components has to be identified. Thirdly, more attention has to be given for the requirement

analysis and design phases, design and implementation phases, implementation phases and maintenance. Finally, the model must incorporate the evaluation of learning and pedagogy models as shown in Figure 2.

The Web-based learning environment is identified and developed for the subjects in the MCA curriculum, which comes under Anna University of Technology, Coimbatore (India).

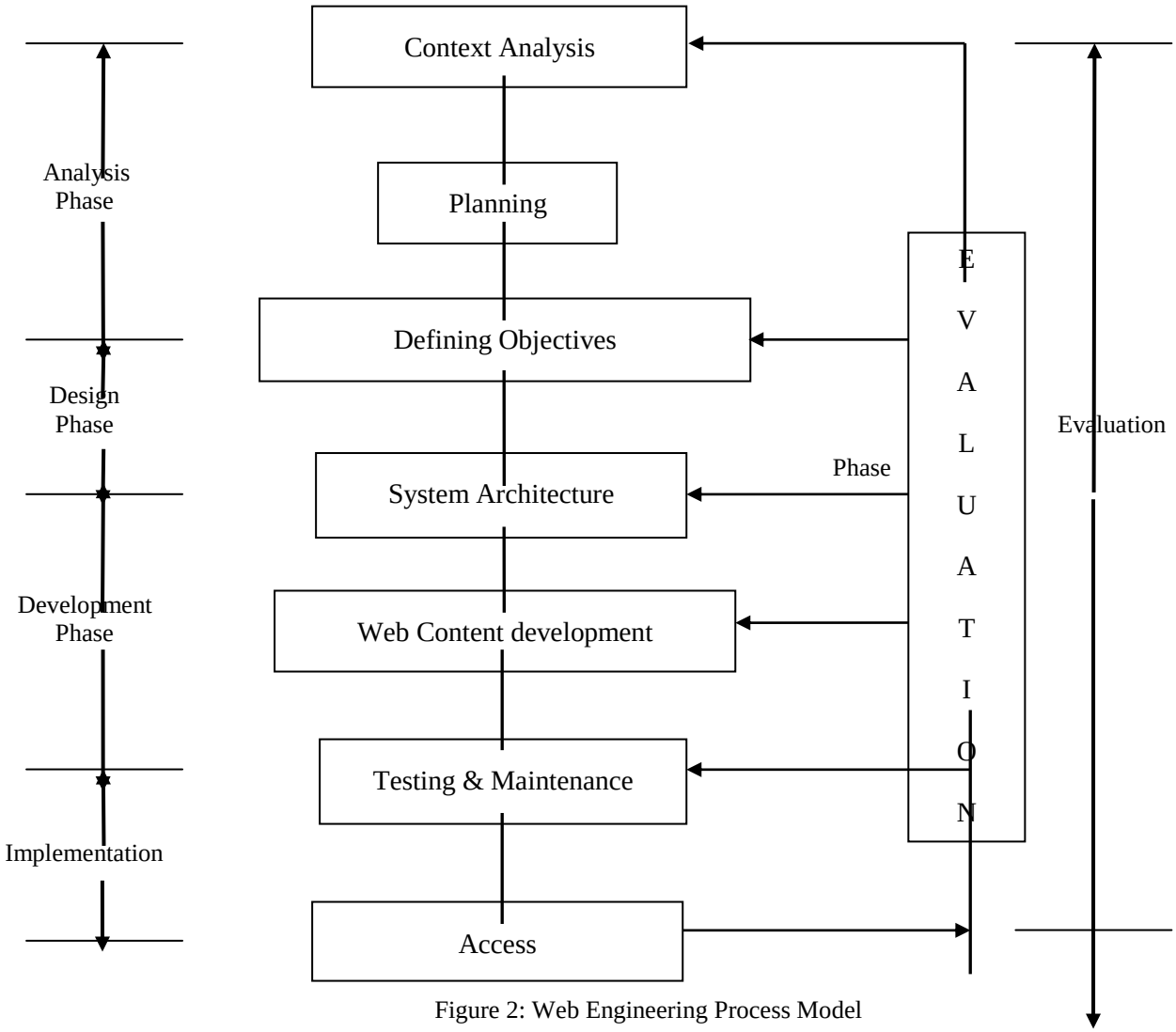

Figure 2: Web Engineering Process Model

VI. IMPLEMENTATION OF THE PROPOSED MODEL

When developing a WBLE, there is a need to follow an iterative process. An iterative process will enable us to divide a complex development task into manageable coherent phases. To develop a iterative process model, identify various activities to be carried out and organize these into some logical order.

Primarily understanding the overall environment within which the application will exist is very much essential. This is called the problem domain. For example, if it is an application to deliver education, the problem domain will include issues such as how the education is delivered at present, what new knowledge is available, what are the specific needs to develop a new Web-based application, who are the users and how will it be used, what are the information goal and application goals, technology available and bandwidth used. Thus, the iterative process model should have appropriate activities to produce these components.

Planning is then to be taken up. The overall project costs are estimated and the risks associated with the development effort are estimated. A detailed development schedule and different experts of stakeholders who may influence the construction of Web-based learning are to be identified.

Information, which is collected from Context and Planning Phases are defined as objectives and it involves gathering information from a range of learners through data collection methods. Technical, Non-technical aspects and system requirements are done using the UML diagrams (Hadjerrouit, 2006).

Formative evaluation has to be done which provides feedback about whether the course achieved its objective.

The learning content is then to be embedded into the on-line environment, Pedagogical model plays an important role for the foundation of learning theory. The suitable combination of behaviorist, cognitive and social constructivism produces a pedagogically strong Web-based learning environment.

The system architecture is the engineering activity which involves both content design and production tasks, including acquiring all the content that is to be included into the Web-based system (e.g., text, graphics, audio, and video). Architectural, navigation, and interface design tasks are performed in parallel**.** These tasks involve the overall hypertext

and hypermedia structure of the Web-based system and the application of design patterns and templates to populate the system structure.

It consists of merging the content defined in the web design and produces executable web pages in HTML, XML, JAVA, J2EE, Authoring tools and other process-oriented languages. It involves revealing the potential errors caused by applets, scripts, forms or the use of various web browsers using alpha testing and beta testing.

The activity is the actual delivery, which involves not just the physical delivery of the course. The WBT, it means running it off a web server and summative evaluation is conducted at the end of the course to measure the degree to which the course its objectives need to be attained.

CONCLUSION

This work provides a framework for understanding the challenges, potentialities, difficulties, and complexity of Web-based learning environment. So far, the conclusions that can be drawn are as follows:

Developing Web-based learning is a complex matter. Web based learning has a number of components and subcomponents, which include both technical and non-technical aspects. There are methodologies, but few that provide an overarching framework for developing Web-based learning environment. The methodology presented in this paper aims to provide such a framework. It attempts to provide pedagogical and methodological foundation as prerequisite for effective implementation of Web-based learning environment.