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A Review on Instructional Design & Content Development Models for e-learning Technology

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Abstract— eLearning is an interactive technology used to translate knowledge into skills. It has become a common way to train employees and students within business and organizations as wells as colleges and universities. This technology is relatively inexpensive and can reach beyond geographical boundaries and space limitations that exceeds traditional classroom training capabilities. In this article, you will explore the various concepts of content development models for e- learning. As you learn these concepts, you will better understand how to make training an exciting experience for the learner. The better you are in applying the concepts such as ADDIE and the various learning theories and styles, the greater success you will achieve in meeting your course objectives. Content Development Model is intended to be used as a ready reference for Subject Matter Experts to provide the relevant content in support of the Development process. As a case study this tool is developed for a Power System Analysis area.

Keywords—Instructional Design, e-learning, Learning theories, subject matter expert

I. INTRODUCTION

Since the mid-1980s or so we have seen the rapid evolution of Computer-Assisted Learning (CAL) and Computer-Assisted Instruction (CAI) into Course Management Systems (CMS) and Virtual Learning Environments (VLEs). From early forays into the use of computers to assist, or indeed provide the entire basis for learning with particular topics to more recent activities involving VLEs and other custom-designed interfaces, the computer has held a fascination for teachers, Lecturers, learning designers and learners alike. At times claims have been hyped: it has been variously claimed that computers would revolutionize learning, bring about the end of the book, put an end to institutionalized learning and/or improve the quality of learning. Rarely have these claims been properly tested. At other times its impact has been overly downplayed, as in the many studies that find 'no significant difference' between face-to-face learning and online learning outcomes[1].

Transformative effects of e-learning, such as creating a distributed community, and learning new genres of communication and collaborative work practice. We now appear to be at a stage of development where we can gauge the impact of the computer on learning in a more measured, critical way, as well as taking a more comprehensive view of changes accompanying e-learning. It is in the spirit of such critique, realism, and expanded view that the present volume has been conceived.

This introduction begins the discussion of e-learning research which is continued in subsequent discussions. The introduction addresses definitional issues, taking time to explore the 'e' and 'learning' in e-learning, then theoretical and methodological issues, before presenting a model of co-evolutionary processes of technology and learning. In choosing to use the term 'e-learning' we have turned away from other names that might equally have been useful, such as computer-assisted learning, Technology-enhanced learning, instructional technologies or online learning. To us, these terms fall into the trap that many previous studies of the relationship between technology and learning/education have fallen into, of assuming that learning exists independently of technologies and that in various ways technologies enhance it. The causal assumptions behind terms such as 'technology enhanced learning' are ones we critique in this introduction [2].

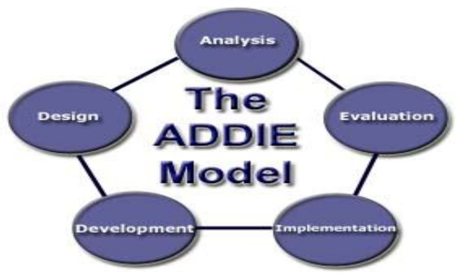
'E-learning' as a term is a hybrid. Like many compounds, the two elements have worked together to create a new hybrid. Nevertheless, it is made up of two parts: e + learning. The 'e' of e-learning has a longer history than many will assume, including long-term efforts to capture voice and images, and to store and then transmit those recordings. With each capture – from records to CDs, film to DVD, conversation to text chat – there are trade-offs in quality, interactivity, and transferability: trade-offs that mark both the pros and cons of technology mediation. The following sections takes us through some of this journey, giving historical and theoretical perspectives on e-learning[3].

The Art of Instructional Design

"Instructional Design is the process of combining information into a logical sequence or flow for an engaging learning experience."

The ADDIE Model

ADDIE is an acronym for Analysis, Design, Development, Implementation, and Evaluation. This model guides you through the process of creating effective educational courses and materials for your students. While there are variations of this model in the industry, the concepts are the same.



As a professional, this model is more than just an acronym. It is a blue print for success. Analysis is the most important step in the process. It helps you to determine the basis for all future decisions. A mistake that many beginners make is not conducting a proper analysis at the beginning. It is this analysis that helps you identify your students, limitations or opportunities, or other important points that will be useful in the design process.

The Design process is the brainstorming step. This is where you use the information obtain in the Analysis phase to create a program or course that meets the needs of your customer or students. There are many forms of the design process and it can be very tedious at times. Testing your concepts in the design phase will save you time and money[5].

The Development phase focuses on building the outcome of the design phase. This process consumes much of the time spent in creating a sound educational program or course. It includes various steps such as initial drafts, reviews, re-writes, and testing. For larger corporations, this phase can involve numerous individuals to include subject matter experts (SME), graphic artists, and technical experts.

For eLearning courses, this phase could require additional assistance for managing server space and technology. The Implementation phase includes more processes than simply presenting the materials developed. While the concepts and materials have been tested throughout the process, the implementation phase can uncover topics that require further development or re-design work. The processes for this phase vary based on the size of the organization, the complexity of the program or course, and the distribution of the materials. This includes such concepts as test pilots, train-the-trainer sessions, and other delivery methods to present the materials.

The Evaluation phase plays an important role in the beginning and at the end of the process. Evaluation objectives reflect much of the discoveries found in the Analysis process. These discoveries include the objectives and expectations of the learner. When looking at the process, you must avoid the thought that it is structured in a chronological order. Rather, the ADDIE Model is a continuous circle with overlapping boundaries. Of all of the process phases, the evaluation phase is the lest understood[4].

The Analysis Process

Often times the analysis process can be overwhelming for the instructional designer. It involves many hours of research and interviewing to improve your skills to determine course expectations for your students. The purpose of the analysis process is to discover as much as you can about the following:

Purpose: One of the first things that you should consider as an instructional designer is to understand exactly what it is that you are creating. Many people overlook this step by assuming various concepts without really analyzing the purpose for creating a course. Understanding why a course or program is needed will help you navigate through the various phases of the ADDIE Model, including the analysis process. Another reason to know the purpose is to identify the actual skills and expectations for the course or program. For example, in the corporate world, all too often managers quickly look at Training as the key to solving all their problems. These managers fail to recognize the difference between "management" issues and "training" issues. To learn more about the design phase for this process click the corresponding link on the menu.

Technology: This is one area that can really hinder your progress if it is overlooked. Before you can build a course or program, you need to know what technology the learner will have available when completing the course. For classroom training, you need to know what types of media are available for you to use. An online course that uses audio for this situation would be worthless to the user.

Evaluation: We include the evaluation process in the analysis phase. This is an important concept that many overlook.

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At the end of the ADDIE process you will evaluate the learner to see if she or he has gained the knowledge or skills expected. Planning an evaluation road map will help you stay on target as you design and develop your course or program. As you begin to analyze the contents of the course, the evaluation becomes a road map and will help you focus on the appropriate topics to include in the materials. In the end, the evaluation of the learner will result in better information concerning performance improvement of the **Students**. To learn more about this process click the corresponding link on the menu[6].

Analysis: The Purpose

The purpose of building that perfect course often gets over looked by assumptions made during the pintail request or idea. The assumption that a problem exists and that you have the perfect solution to fix it is a temptation experienced by many instructional designers. Yet, analyzing the real problem can save you time and money. Before you can build that perfect course, you must understand the "real" purpose for the instructions. Consider the following:

II. STUDENTS ANALYSIS

Students analysis is one of the most important steps of the ADDIE process. Before you can design a curriculum, you need to know what your Students is required to learn. The following formula will help you in analyzing your Students.

Required Skills - Current Skills = Curriculum Objectives

Required skills are based on the assessment of what the Students must know in order to do that which is new to them. For example, if a company bought a new computer program for its employees, then there are certain skills that employees must have in order to use the new program. Identifying these skills will help you to compare them with the current skills of the employees. The difference between the required skills and the current skills become your curriculum objectives.

Curriculum objectives are critical in building a strong and effective course or training program. Everything is base around these objectives including tests and evaluations.

How to identify Required Skills

Identifying required skills can be challenging if you lack the resources or product knowledge. The best way to identify these skills is to breakdown the topic into smaller topics. A widget, for example, can be separated into individual segments by functions, parts, sections, or components. As you breakdown the individual parts, you begin to identify key skills that must be attained to use the widget. Each topic, product, or subject brings unique challenges and offers the instructional designer an opportunity to identify specific skills that will add value to the course or training program[7].

The Students analysis tool will help you identify course objectives for the curriculum you design. By listing the required skills and the current skills, you can determine which skills must be emphasized during the course. When starting to build a new course or training program, it can be difficult to identify what to focus on. This tool will walk you through the process to quickly identify your objectives for the course.

To use the tool, you will first list all required skills for the topic. Next, list current skills related to the required skills. If you notice differences or gaps between the required and current skills, list them in the Curriculum Objective column. Once you have completed tool, you are ready to analyze the data and to determine the objectives that you will use to design and build your course or training program.

Content Development Overview

CDO is intended to be used by Engineering college (B.E / B.Tech level) students, faculty and management. It delivers the following:

A. Tutorials – The objective of Tutorials is to reinforce the classroom instructions in a self-paced, anytime, anywhere method. The content is organized in logical order with supporting images, animations, simulations. It also provides Practice Zone, where multiple reinforcement techniques were provided to the students[8].

B. Teaching Aids – These aids provide teachers with optimal lesson plans, multi-media support and access

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to pedagogic tools drawn from Tutorials. These aids help teachers to optimize the content for teaching and also ensure better learning outcomes for the students.

All this content is hosted on a cloud-based platform and delivered to the users over a Virtual Learning Environment (VLE) using the Software-as-a-Service mode[9].

Phases of Content Development

- ❖ Analysis Phase
  - o Body Of Knowledge (BOK) – Identification, Breakdown and Concept Categorization by the Subject Matter Experts.
- ❖ Design Phase
  - o Pedagogic Note (PN) : Detailed indication of "What" content is required including sub-concepts and also "How" to present the same will be captured in this phase.
- ❖ Development Phase
  - o Story Boarding (SB) - Based on the PN, content will be articulated (slide by slide) along with instructions on images, animations, simulations will be prepared.
- ❖ Production Phase
  - o Graphic Development (GD) – Converting the SB into the final output using the graphic enhancements as per the SB.

BOK Document :

Module	Unit	Concept Title	Teaching Aid	Taxonomy Levels

Taxonomy Levels

LEVEL	Taxonomy of Knowledge	Guidelines	General verbs used to represent
1	Facts/Knowledge	Where presentation consists of Facts / Knowledge of the concept	Listing, Label Name State Defining
2	Comprehension	Where the presentation consists of Comprehension/ Understanding the concepts	Explaining Summarizing Paraphrase Describe Illustrate
3	Application	Where the presentation consists of Application of the concepts	Use Compute Solve Demonstrate Apply

			Construct
4	Analysis	Where the presentation consists of Analysis of the concept	Analyze Categorize Compare Contrast Separate
5	Synthesis	Where the presentation consists of Synthesis of the concept	Create Design Hypothesize Invent Develop
6	Evaluate	Where the presentation consists of Evaluation of the concept	Judge Recommend Critique Justify

Concept Categorization

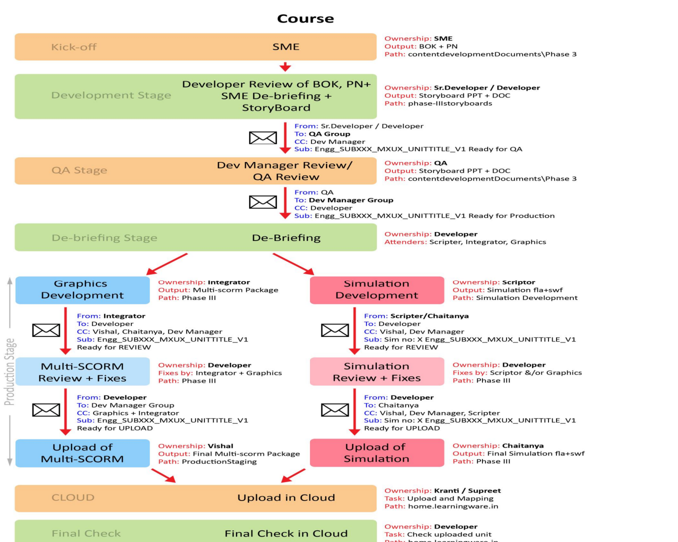
Concept Level	Taxonomy of Knowledge	Guideline
1	Facts	25%
2	Comprehension	30%
3	Application	25%
4	Analysis	20 %
5	Synthesis	
6	Evaluate	

DESIGN PHASE

Pedagogic Note preparation – Treatment of the content

Pedagogic Tool mapping – This is the process to apply the appropriate pedagogic tool for each Concept.This prescription for treatment of a Concept is based on the Concept Category defined in the last activity.

FLOW PROCESS



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CASE STUDY

Body Of Knowledge : Power System Analysis

Body Of Knowledge (BOK)

Course Name:Power system analysis — Author:
Department: Electrical and Electronics Engineering — Version: BOK

S.No.	Module	Unit	Concept	Teaching Aids	Category
1	1: Power system Network Matrices-I	1. Graph Theory	Neccessity for modeling and identification	TA1: Representation of Electric power system	1
2			Representation of Electrical power system		2
3			Representation of primitive network		2
4			Definitions of graph theory	TA2: Graph theory	1
5			Formulation of Incidence Matrix	TA3: Incidence Matrix	3
6		2.Formulation of Ybus	Various methods of forming Ybus	TA4: singular transformation	1
7			Formulation of Ybus by singular transformation		4
8			Formulation of Ybus by direct transformation	TA5: Direct Transformation	4
9	2.Power system Network Matrices-II	1.Building Bus impedance matrix	Partial network and algorithm for bus impedance matrix	TA6: Addition of branch	2
10			Addition of branch in bus impedance matrix		5
11			Addition of link in bus impedance matrix	TA7: Addition of link	5
12		2. Modification of Zbus matrix	Computation of self impedance	TA8: Modification of Zbus	2
13			modification by removal or change in impedance of elements		4
14	3. Power flow studies-I	1. Gauss siedal method without PV bus	Necessity and data for power flow studies	TA9: Load flow equations	1
15			Static Load flow equations using nodal admittance matrix		3
16			solution of load flow using Gauss seidel method	TA10: Gauss siedal method	6
17			Flowchart of Gauss seidel method without PV bus	TA11: Flowchart of Gauss siedel method	2
18		2. Gauss siedal method with PV bus	significance of acceleration factor	TA12:Gauss seidel method with PV bus	1
19			solution of load flow using Gauss seidel method		6
20			Flowchart of Gauss seidel method with PV bus	TA13: Flowchart of Gauss siedel method with PV bus	2
21	4.Power flow studies-II	1.Newton-Raphsons method using rectangular coordinates	Newton Raphsons Algorithm without PV bus	TA14: Newton Raphson method without PV bus	5
22			Flowchart of Newton Raphsons method without PV bus		2
23			Newton Raphsons Algorithm with PV bus	TA15: Newton Raphson method with PV bus	5
24			Flowchart of Newton Raphsons method with PV bus		2
25		2.Newton-Raphsons method using polar coordinates	Newton Raphsons Algorithm without PV bus	TA16: Newton Raphson method without PV bus	5
26			Flowchart of Newton Raphsons method without PV bus		2
27			Newton Raphsons Algorithm with PV bus	TA17: Newton Raphson method with PV bus	5
28			Flowchart of Newton Raphsons method with PV bus		2
29			Decoupled and fast decoupled load flow methods	TA18: modifications in load flow techniques	3
30			Comparison of various methods	TA19: DC load flows	1
31			Calculation of DC load flow		2
32	5. Short circuit Analysis-I	1. Per-Unit representation	Need for Per unit representation	TA20: Representation of single line diagram	1
33			single line diagram of power system		3
34			3 phase and 1 phase system in per unit quantities	TA21: Representation of 3 phase and 1 phase system	2
35			per unit representation of transformer	TA22: Representation of transformer	3
36		2. Symmetrical component theory	Types of symmetrical components	TA23: symmetrical component theory	1
37			Relationship between phasors		2
38			Various types of sequence impedances for transmission line	TA24: Sequence impedances for transmission line	3
39			sequence impedance and network of power system	TA25: Sequence networks	4
40	6.Fault Analysis	1.Symmetrical fault analysis	Classification of faults		1
41			Transients due to short circuit in transmission line	TA26: Short circuit in transmission line	3
42			Transients due to short circuit in 3 phase alternator	TA27: Short circuit in 3 phase alternator	3
43			limitation of fault current	TA28: Series reactors	2
44			Application of series reactors		2
45		2.Unsymmetrical fault analysis	Analysis of LG fault without fault impedance	TA29: Analysis of LG fault	4
46			Analysis of LL fault without fault impedance	TA30: Analysis of LL fault	4
47			Analysis of LLG fault without fault impedance	TA31: Analysis of LLG fault	4
48			Analysis of LG fault with fault impedance	32: Analysis of faults with fault impedan	4
49			Analysis of LL fault with fault impedance		4
50			Analysis of LLG fault with fault impedance		4
51	7.Steady State Analysis	1.Basic concepts of steady state analysis	Types of stability	TA33: Concepts of steady state stability	1
52			Expression for steady state power		5
53			constants of rotating machines	TA34: Power angle curve	2
54			Power angle curve		2
55		2. Determination of steady state stability	Analytical Determination of steady state stability	TA35:Determination of steady state stability	6
56			Graphical approach to determine stability		5
57			Methods to improve steady state stability		1
58	8. Transient State Stability Analysis	1.Swing Equation	Derivation of swing equation and analysis of swing curves	TA36:Analysis of swing equation	4
59			Determination of transient stability by equal area criterion	TA37: Equal area criterion	4
60			Calculation of critical clearing angle	TA38: critical clearing angle	3
61		2.Solution of swing equation	Solution of swing equation by point-by-point method	TA39: point-by-point method	5
62			Solution of swing equation by Runga-kutta method	TA40: Runga-kutta method	5
63			Methods to improve transient stability and auto reclosing circuit breakers	TA41: Methods to improve transient stability	1

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