

A Layers-of-Quality Model in Online Course Design: The Five-E Model

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This paper describes a layers-of-quality model for designing e-Learning environments based on frameworks and models of instructional design (ID) applied in a hierarchical fashion. There have been a number of theories and models in the field of ID and technology that can be applied to make e-Learning a better quality. However, little is known about how to select appropriate models for improving various aspects of e-Learning. This paper proposes a cohesive model, the Five-E Model, for selecting the right model and techniques for appropriate purpose in e-Learning design, thus providing a scheme for better utilizing the existing knowledge base in designing and evaluating e-Learning practices. A further agenda for constructing a more robust model is also discussed.

Keywords: layer-of-quality model, instructional design, The Five-E Model, e-Learning

Introduction

It has been a universal concern about how to evaluate, assure, and improve the quality of e-Learning. From an instructional design (ID) point of view, many models and techniques have been proposed to make design quality of e-Learning better in various aspects. These consist of how to make the material easy to navigate, how to make the material easy to comprehend, how to make the material more attractive, and so forth. Merrill (2002) advocates the quality of e-Learning to be expressed by the 3rd power of e-Learning: effective, efficient, and engaging. To that end, Merrill has proposed the first principles of ID, taking into consideration of the five design elements: (1) real-world task centered, (2) activation of learners' knowledge and experiences, (3) demonstration of the contents using examples, (4) application of the target skills, and (5) integration of the learned skills into the real world problem-solving situations. To expand scheme of instructional outcomes, Wilson, Parrish, and Veletsianos (2008) recently proposed to add two more considerations to Merrill's effective, efficient, and engaging instruction. One is good instruction, which leads learners to valued ends while minimizing any negative impacts. The other is transforming instruction, which encourages deeply engaging experiences that can potentially transform identities and practices of the learners. Aesthetic

concern and story telling have been new growing issues in the literature of ID (Parrish, 2005, 2006, 2007; Wilson, 2005). In order to expand mechanical and analytical nature of ID, they try to bring about more memorable and easy-to-follow storylines in the learning experiences, just like other forms of artistic experiences. Instructional use of games and simulations has been another important trend in ID, which has recently been called “Serious Games” (Aldrich, 2005; Prensky, 2006).

No universally accepted guideline for assuring quality of e-Learning has been agreed upon, although many have been suggested worldwide. The first of the kind is known as Quality on the Line, proposed by the Institute for Higher Education Policy, in which, a total of 24 benchmarks in Institutional Support, Course Development, Teaching/Learning, Course Structure, Student Support, Faculty Support, and Evaluation and Assessment were identified. According to Wang (2006), the most widely followed guidelines are provided by The Council for Higher Education Accreditation (CHEA, 2002), Council for Regional Accrediting Commissions (C-RAC, 2000), and The American Federation of Teachers (2000). Another widely known Sloan-C’s framework (Moore, 2002; 2005) consists of five interrelated aspects: Learning Effectiveness, Cost Effectiveness and Institutional Commitment, Access, Faculty Satisfaction, and Student Satisfaction, which are known as the Five Pillars. In the European e-Learning community, European Quality Observatory (EQO) provided a general conceptual framework in order to compare and adjust e-Learning products, which consists of two components: the repository (information/knowledge base) and community (Pawlowski, 2003).

Quality issues have been rather separately discussed, partly because of the multi-facet nature of e-Learning (Kidney, Cummings, & Boehm, 2007; Ellis, Jarkey, Mahony, Peat, & Sheely, 2007). From the standpoint of a learning environment, such aspects as adequacy and amount of information and fluency of communications may be issues. From a technical point of view, comfort in use, efficiency of information maintenance, language and platform, and/or functionality of the information repository may be sought. In addition, a material design perspective would concern the effectiveness of multimedia utilization, intellectual property handling, or cost effectiveness of production. It is also totally different to see from the perspectives of the learner, instructor, instructional designer, web creator, information technologist, or manager, about what they expect of a high quality e-Learning (Broadbent, 2002).

In order to improve the design quality of e-Learning, a cohesive framework should be generated from models available in the literature of ID that can be used to serve for various aspects of e-Learning design. Many models and techniques have been proposed in the field of ID, but they are not widely known to policy makers and practitioners in the field of e-Learning. The more advanced the study of ID, the more it would become difficult for those who are not familiar with the advancement in the field to make the best use of the existing research outcomes. It is therefore the intention of this paper to propose a layers-of-quality model in online course design as a learner-centered hierarchical framework, or a meta model, to show five layers of e-Learning quality. The model is intended to serve as a framework for categorizing the existing ID models and techniques, as well as for building new models and techniques.

A Layers-of-Quality Model: The Five-E Model

A layers-of-quality model was first proposed by Suzuki (2006; Suzuki & Keller, 2007). This layered model was proposed as a frame of reference for clarifying the purposes of various ID models and techniques, and to illustrate how they can be meaningfully organized in terms of purpose and impact. This organizational structure has several intended benefits: It clarifies the relationships among the various design activities in e-Learning development, it can provide guidance to e-Learning designers, and it can help managers of e-Learning development who must coordinate a team of designers.

In this model there are five layers. Layer 3, Easy e-Learning, considered to be the baseline level, is actually at the midpoint of the five layers. There are two layers below it, which are Ecological and Exact e-Learning, and two above, Effective and Engaging e-Learning. The model is named the Five-E Model, since each level starts with a letter E: Ecological, Exact, Easy, Effective, and Efficient. The organization is guided by the concepts of Herzburg's (1968) motivator-hygiene theory of motivation. He postulated that certain activities, called hygiene factors, help avoid discontent or annoyance and keep people happy, while other kinds of factors, called motivators, contribute to meaningful work experiences and stimulate people to achieve the goal. This theoretical foundation is reflected in the following layer descriptions, layers forming a kind of hierarchical structure among them. The layers do not necessarily show the procedural order of design activities; however, they are hierarchical in that the low quality of a lower layer would have a negative influence on upper layers.

Good usability features help avoid learner annoyance (a hygiene factor), but may have limited effects on learning. It is thus located in the model as the center layer, separated from the above layers of learning and motivation (Layers 4 and 5). Usability is important to secure learner motivation by reducing distractive factors from learning environment. However, the aims of ID are not only concerned with usability, but also with other issues, although all are interconnected. By putting the usability issue as Layer 3, the model tries to separate other design techniques according to whether they fall into the hygiene levels (Layers 1 and 2), which are positioned below Layer 3, or the motivator levels that are above it (Layers 4 and 5: See Figure 1).

Layer 1: Ecological e-Learning

The bottom layer of the Five-E Model is learning environmental design, called Ecological e-Learning. Layer 1: Ecological e-Learning concerns the issue of avoiding irritation by having proper learning environment, via adequate bandwidth, audio quality, and stability of the service. Such issues should be met to avoid learner's "pain," in regard to the "hygiene" elements of design (Herzberg, 1968). The presence of such technological problems would distract any audience from learning, but would not, in and of themselves, produce learning. This is the reason why this layer is placed at the bottom. Activities in the field of ID at this level include learning environment analysis, media selection techniques, and technology support (Keller & Suzuki, 1988).

Quality of e-Learning	Achievement Index Examples	Major ID Techniques
Layer 5: Engaging Willing to Learn (Motivation Design)	Continuing motivation, Immersiveness, “Did I do this many without noticing?” Link to future self, Self-directed, self-responsible, individual taste, Volition, Brand, Pride, Ownership	ARCS Model, Andragogy, Aesthetic Design, Serious Games
Layer 4: Effective Easy to Learn (Learning Design)	Learning environment matching nature of the task, learning support matching learner needs, interaction effects of collaborative members, self-regulated learning, responsive environment	Nine Events of Instruction, Structuring & Sequencing, First Principles of ID
Layer 3: Easy Friendly (Information Design)	Operatability, Usability, Navigation and Layout, faster and more accurate access to needed information, No disorientation problem	Technical writing, Rapid prototyping, Formative evaluation
Layer 2: Exact No Deception (Content Design)	Content accuracy, Validity of Learning Scope, Validity of interpretation, Indication of equivocality, Freshness of Information, Rational and reliable, Intellectual Property Handling	Needs Analysis, Task Analysis, Content Analysis
Layer 1: Ecological No Pain (Environment Design)	Access environment, Adequate network speed, Substitute alternatives for different IT environment, Stability of service, Feeling of security	Learning Environment Analysis, Media Selection Models

Figure 1. *The Five-E Model of Online Course Design*

Learning environment analysis represents techniques to assess the existing environment for learning in terms of media attributes of contents and available supports for learning. Media selection models have long been investigated in the field of ID, to attain not only attractiveness of environment, but also effectiveness and efficiency. Although “simple media, active students” is the conclusion derived from media studies (Schramm, 1977), many have argued various effects of media on learning. It has been widely accepted that different media can provide different learning environments serving for more/less effectiveness in producing learning. It has also been widely known that different media cost more/less in preparing and implementing learning environment. Thus, making the proper combination in selecting and utilizing media is critical in composing learning environment from the standpoint of avoiding “pain” in learning environment.

Layer 2: Exact e-Learning

One layer above Ecological e-Learning (Layer 1) is Layer 2: Exact e-Learning. It includes analysis of content and concerns of the potential deception in e-Learning programs. If the content is not accurate, valid, nor reliable, then attaining high usability and effectiveness of such content has not much meaning. It may be bad to attain engaging e-Learning, when the content is biased or with potentially harmful intentions. Being thus placed one layer above Layer 1, the issue of content design (Layer 2) has the prerequisite importance over information design (Layer 3).

ID techniques used during the analysis phase, such as needs analysis, content and task analysis, deal with this issue. Needs analysis is an ID technique to specify the reason why any e-Learning must be provided for a certain potential group of users. Needs may come from job-related knowledge and/or skill deficiencies, changes in environment, such as a release of a new version of software, or prospective future trends in a proactive mode of training. Often times the analysis of needs will call upon specification of changes in job-related behaviors as a result of training. In order to connect training results to performance change in application settings, Kirkpatrick's (1998) 4 level evaluation scheme (Reaction, Learning, Behavior, and Result) is the most well-known in the ID literature.

Content and task analysis refers to the process of specifying how many components are there between the learner's current status and goal status, and how each of the components is related to each other. Starting from Gagne's (1968) classical hierarchical analysis, many techniques have been proposed about how to conduct content and task analysis (e.g., Reigeluth & Stein, 1983). Having conducted content and task analysis, the designer of e-Learning can be sure about what should be covered in the course, and which of the components can be covered prior to, or only after, the others. Each component should have a clear statement of learning objective, which is accompanied with a set of test items. Defining clear objectives and writing corresponding test items has been one of the traditional and well-established techniques of ID.

Subject Matter Experts (SMEs), who provide expertise in the area of the target content, would play a major role in determining the components. SMEs can provide for content accuracy, validity of learning scope, validity of interpretation, indication of equivocality, freshness of information, rational and reliable contents. SMEs should work together with the instructional designer in charge of e-Learning design and development. Intellectual property handling of the materials may play an important role regarding which graphics, pictures, and other copyrighted materials can be included. It is one of the major roles of instructional designers to aggressively interview the SME to extract necessary information so that the e-Learning attain accuracy. By including all the necessary content and eliminating "just nice to know" elements, one can attain efficient e-Learning to save cost of developing and implementing, as well as time of learners.

Layer 3: Easy e-Learning

The next layer up concerns how easy it is to use the e-Learning (Layer 3: Easy e-Learning). Newcomers to the field of instructional design (ID), especially those with information technology or media production background, often think of ID as an equivalent of navigation and display design. The goal is to accomplish high usability and user-friendliness. Although it is important to have an easy-to-use system or materials for e-Learning, it may not facilitate the learner to attain learning objectives merely by having a series of good-looking screens. It should be considered as a set of separate, more basic techniques to make e-Learning friendly, or easy to use, which is different from making it effective in facilitating learning. It is important to accomplish easy e-Learning by utilizing such techniques as navigation design, usability design, technical writing skills and display layout principles. However, those techniques may not guarantee that the users of e-Learning will learn the material and accomplish the learning goals.

Formative evaluation and rapid prototyping are examples of ID techniques to attain high

usability. During the development phase of e-Learning, or any other forms of learning materials, data will be gathered from potential learners and other stakeholders to verify if basic structure and the way to represent learning materials would fit the users preferences. Various models have been formalized as formative evaluation and rapid prototyping techniques.

Layer 4: Effective e-Learning

This layer just above Layer 3 (Easy e-Learning) concerns the design of e-Learning to support learning (Layer 4: Effective e-Learning). Most of the works in the ID field have been concerned with how to make learning effective. In other words, the goal is to ensure that the instructional interventions match both learner characteristics and task requirements in a given environment. Matching instructional strategies with characteristics of the learner, the task, and the environment is critical because no single method of learning is the best for all kinds of learning. As it is said that “there is no panacea,” different kinds of learning tasks require different sets of learning environment to be effective. Different kinds of learner characteristics would call for different sets of instructional strategies to be most effective. Thus, matching features in the learning environment with natures of both learners and learning tasks is considered to be important.

Various ID models such as the ones in Reigeluth’s (1983, 1999) “Green Books” are the examples in this layer. Since effective e-Learning will facilitate the learners attaining objectives, by definition, ID models typically relate such factors as learner’s characteristics, nature of the learning task, and learning environment to instructional strategies. In other words, ID models propose ways to attain the best fit among elements in the learning environment. Gagne’s (2004) learning outcomes and conditions for effective learning is one of the classical models in this direction, by defining a minimum set of learning tasks calling different kinds of essential conditions for learning.

Further advancement has been made to reflect the paradigm shift in the fields of constructivist psychology and learning sciences, which was well represented in Reigeluth’s (1999) second volume of the “Green Book II.” Many ID models and theories have been proposed, and much more will be proposed in the future, stemming from design efforts in various setting for various circumstances, as well as from advancement in the related research including brain sciences. Efforts in integrating those models, such as Merrill’s (2002) First Principles of Instruction and Reigeluth’s “Green Book III” toward common knowledge base (Reigeluth & Carr-Chellman, 2009), would be necessary to find out what are in common across different ID models.

Layer 5: Engaging e-Learning

The top layer (Layer 5: Engaging e-Learning) is about the appeal of e-Learning. It is about keeping learners motivated and engaged in learning, wanting to be involved in the learning activities more, even when they are not required, or being happy about belonging to the organization that provides the learning environment. Appeal of instruction has been considered to be one of the three main goals of ID: effectiveness, efficiency, and appeal (Reigeluth & Merrill, 1978), or effectiveness, efficiency, and engagement (Merrill, 2002). Techniques and models for this layer include motivational design principles (Keller, 2008), the principles of

adult learning (Knowles, 1984), strategies for adult motivation (Wlodkowski, 2008), and aesthetic design principles (Parrish, 2007).

The ARCS model of motivational design has been one of the major ID models that geared directly toward the attainment of appeal of instruction, or engagement of the learners. It has been widely used in various sectors of e-Learning practices world-wide (e.g., Keller & Suzuki, 1988). The ARCS stands for four major factors associated with learner motivation: Attention, Relevance, Confidence, and Satisfaction. Numerous motivational strategies have been suggested and validated in various learning settings, each of which is classified into one of the four categories. The model also has a set of procedures to deploy the motivational design, from learner analysis, selection of motivational objectives, to test and revise the e-Learning environment. Keller (2008) recently proposed the five first principles of motivational design, by adding volitional (self-regulatory) strategy principle to the first four ARCS principles.

Knowles (1984) has often been cited for his work of proposing Andragogy for adult learning, as opposed to pedagogy for children's learning, in the literature of ID in the context of creating learner-centered learning environment for adults. Wlodkowski (2008) has described a set of 60 motivational strategies for adult learning, covering four areas: (1) Inclusion (awareness, feeling of connection, and climate of respect) and (2) Attitude (toward subject matter, self-efficacy, learning goals, and learning experiences) at the beginning of learning activities, (3) Meaning (interest, engagement, challenge and adaptive decision making) during learning activities, and (4) Competence (assessment, transfer, and rewards) at the ending of learning activities. Parrish (2007) proposed five aesthetic principles of ID, by following the four elements of critical literature (plot, characters, theme, and context) and by adding the fifth element of instructor or instructional designer, playing roles of authors, supporting characters, and model protagonists. The aesthetic concern is expected to serve for the Layer 3, by avoiding to produce "un-engaging, and therefore ineffective products," and by encouraging instructional designers not to "beholden to the dry, yeastless quality of their work and rarely discuss their role in inspiring and moving learners (Parrish, 2005, p.17)."

Analysis of an Online Graduate Program

To illustrate how the layers-of-quality model can be used, an online Master's program at Kumamoto University, Japan was analyzed retrospectively. The Instructional Systems Program started in April 2006 as a fully online Master's program for training e-Learning specialists in business and industry and higher education (Suzuki, 2007). It offers 30 courses, two credits each, fully online mainly for those who are working full time to seek advanced and organized education at a graduate level, majority of whom do not live near campus. In order to be approved by the Japanese government as an equivalent of an on-campus program, 15 interactive sessions are required in each course aligning to the approved course outline.

To make the program free from technical distractions (Layer 1: Ecological e-Learning), a high performance PC and broadband network connection was required for all prospective students, whether at home or at work, in order to assure enough speed to view our multimedia content. Year around availability was guaranteed except for one day campus-wide power down and

monthly night time updates of the Learning Management System (LMS). It is considered to be a rather stable service, when compared with distance students in a campus-based university suffering from daily maintenance shutdowns between 4 - 6 am every day, for example.

Professors from various fields joined the program to offer not only ID courses, but also information technology, management, and intellectual property (IP). Where within university expertise was unavailable, part-time lecturers were located with cooperation from National Institute for Multimedia Education and e-Learning Consortium Japan (eLC), to provide the first class content in all the courses provided (Layer 2: Exact e-Learning). Intellectual property policies were set by consulting with the professor who teaches the IP course in the program. All course content and assignments were aligned with the program's overall educational goals, which was announced in the form of competencies at graduation, so as to avoid unnecessary or "just nice to know" elements in the course content.

A set of course design policies was established and shared among professors and staffs to offer a cohesive look and feel in the course materials (Layer 3: Easy e-Learning). For example, all courses, which consist of 15 lessons, were divided into 3 to 5 units of learning modules, each of which has corresponding assignments under a theme within the course. Students can structure the coursework by aiming to finish an assignment by taking several lessons with an interactive element (called a task) in each, before submitting the assignment. Navigation in each course is standardized by utilizing functions of the commercial LMS. Then, the bridge is provided among all the courses a student is simultaneously taking in a particular semester by originally creating program's learning portal site (Nakano et al., 2007). An easy navigation is provided in the program portal by listing all the courses' tasks and assignment, indicating deadlines and submission status (passed, or resubmission required) with direct links to the respective course content. Online orientation was designed and implemented to familiarize the students with the above mentioned functions in the learning environment, as well as acts of speaking up online to the colleagues who take the same courses.

To make the best use of ID principles, which the program emphasizes as specialization of e-Learning professionals, careful design including the course design policies and list of competencies was conducted in the design phase of the program (Layer 4: Effective e-Learning). Tasks and assignments were set to be as authentic as possible, the information as concrete and various as possible, and opportunities for feedback and multiple challenges as much as possible. Also, learning objectives and evaluation criteria are set and announced as clear as possible, and peer interactions are introduced so the students have opportunities to learn from each other's experiences in and viewpoints from different application fields. Prerequisite relationships among courses are specified and announced in advance, so that cumulative learning effects can be obtained.

To make the program attractive (Layer 5: Engaging e-Learning) to the prospective target student population as well as to the current students, the program has been aligned to the requirements of eLC's e-Learning Professional Certificates. All the graduates are entitled to be certified as Learning Designer by eLC upon the completion of the master's program. For those who take necessary elective courses, other certificates such as Manager, Contents Creator, SCORM Engineer, Expert, and Consultant will also become eligible. Since the program is operated

totally online, the students do not see each other in the coursework. However, we set up occasional social events for students and faculty to see each other, at research meetings, conferences, etc. The last item of the Core Competency List states “To contribute to improvements and advancements of the GSIS program as an alumnus.” Toward that end, various efforts have been made to emphasize the bond among faculty and students. Upon the first graduation in March 2008, an alumni association was organized by a voluntary group of graduates. It is expected that the association continuously serves for our program to make it more attractive to the current and prospective students, as well as to the alumni themselves.

By going through the design elements of the online graduate program using the Five-E Model, it was confirmed that the program had been well designed, at least for the lower layers of the model. The learning environment was planned to avoid irritation of the learners, and the content was prepared to secure the first-class quality representing the latest status of subject matter expertise. User friendliness, or information design, was restricted by the commercial LMS adopted by university-wide decision, but it was sufficient enough to implement what we thought to be necessary functions to realize the design policies, serving to secure quality at Layer 4. The original learning portal was an important addition to the commercial LMS, in order to provide easier access to the contents of multiple courses that each student was taking concurrently in a given semester, which was not available in the commercial LMS.

For the top layer of the model, motivational design for engaging e-Learning, the link to the outside real-world has been established by connecting course contents to professional certificates. However, aesthetic concern was not enough in the initial design of the program. It is now evident, by reflecting what has been done in the initial design and revisions of the program, why we decided to revise our program by introducing story-centered curriculum (Suzuki, Nemoto, Oyamada, & Shibata, 2008). It was aimed to bridge the individually offered courses by adding a hypothetical story of an e-Learning professional so that the students would see the future value of studying each of the required courses. It was to improve the design quality of the initial program at Layer 5, by adding overarching story to connect all the required courses.

Concluding Remarks

Based on these concepts and examples, this layers-of-quality model can provide a useful frame of reference among practitioners in e-Learning, so that proper techniques are to be utilized for proper aims. Other models using layers have been widely used in ID. These include the Cone of Experiences proposed by Dale (1954) to categorize various forms of involvement and retention of information from different types of educational media, and Maslow’s (1943) hierarchy of human needs which helps identify learning readiness based on motivational states. Tessmer and Wedman’s (2000) Layers-of-Necessity Model helps explain a progression from limited, or rapid, prototyping prior to engaging in a more full featured development process depending on the needs of the situation. Gibbons’ (2003) model of centrism, moving from media centrism to message, strategy, and to model centrism, describes how major concerns of novice instructional designers tend to shift as they mature. In search of why these shifts in centrism occur, Gibbons identified seven important layers of ID: the layers of content, strategy, control, message, representation, media-logic, and data management. But, none of the other “layered models” has

illustrated the various goals of design activities in relation to learner satisfaction (hygiene factors), learning, and motivation, in a hierarchical fashion. It is authors' hope that the proposed model will serve a function to become an easy-to-understand mental framework for those who are new to the field of instructional design to contribute to evaluate, assure, and improve the quality of e-Learning in various settings.

In order to realize such hope, future research agenda should include the following studies:

- 1) A study or series of studies aiming at determining learning outcomes and satisfaction measures for real students taking courses designed using the Five-E Model.
- 2) A study to explore if explaining e-Learning design cases in terms of the Five-E Model would enhance clarity and persuasiveness of narratives for novices.
- 3) A study to analyze existing cases of e-Learning to see if applying the Five-E Model would enhance the validity of evaluation, as well as provoking ideas for improvement.
- 4) A study to create a new case of e-Learning based on the Five-E Model to see if and how much the model would help the process of design at various layers described in the model.
- 5) A study to create a Web site of the Five-E Model to help publicize the model, based on the design element suggested by the model itself.

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