When it Comes to E-learning

Joseph Bih
Email: jjmbih@ieee.org

I. INTRODUCTION

E-learning is fast becoming a major learning and skills delivery method within larger companies as a staff development tool. Survey shows that among American colleges and universities in 2002, 11% of students took an online course, 97 % of public institutions offered at least one online or blended course, 49% offered an online degree program, and 67% considering e-learning a critical long-term strategy for their institution. The questions about e-learning have become "how", "why" and "with what outcomes".

E-learning can enhance the competency in new skills and aid knowledge management – thereby boosting productivity, innovation and the spread of best practice. And while the range of courses and materials generally available has been primarily limited to generic and 'soft' skills, there is a body of more product specific e-learning development which can be drawn upon. This raises the question of when e-learning will become an established and integrated part of the total educational process, rather than a fashionable accessory to work-related training in well-resourced businesses.

However there are significant challenges to the successful inculcation of the practice and process of e-learning into the fabric of the educational system. These challenges manifest themselves in many ways – cultural, organizational, financial and curricular.

II. E-LEARNING EVALUATION MODELS

With the daily increase of online course offerings, most universities and corporate training facilities now offer some or all of their courses online. Studies shows, that more than 1,000 corporate universities and online providers offer courses in everything from information technology to cuisine recipe. Although it is clearly advantageous for asynchronous learners to access educational information and content anywhere and anytime, it is difficult to evaluate the quality and effectiveness of online courses and learning modules.

A. Interactive learning Model

As open source learning platforms and public access to online course content are gaining momentum, educational institutes can benefit from joint development efforts and shared resources, resulting in lower cost of online learning. Consortia are sharing volumes of information and courseware based on current technologies. In approach to develop a common, objective scale and summative instrument with which to measure the pedagogical effectiveness of online course offerings, Sonwalker uses the five functional learning styles (as figure 1) - apprenticeship, incidental, inductive, deductive, and discovery (x-axis); the six media elements - text, graphics, audio, video, animation, and simulation (y-axis); and the third axis of the cube (the z-axis), which represents the interactive aspects of learning.

Figure 1: The learning cube

Learning styles: L1 = apprenticeship; L2 = incidental; L3 = inductive; L4 = deductive; L5 = discovery
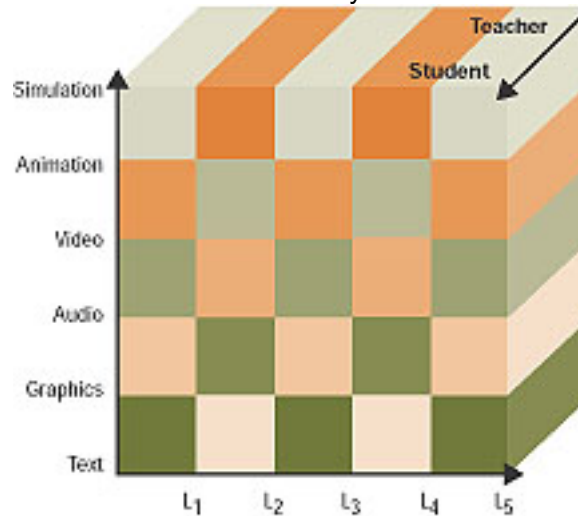
The z-axis indicates the degree to which students are engaged with the learning content, moving from a teacher-oriented to a student-oriented approach. This interactivity axis (z-direction) of the cube can be defined in terms of five elements: system feedback, adaptive remediation and revision, e-mail exchange, discussion groups, and bulletin boards. With this definition of the learning cube, a framework can be constructed to define pedagogy as a 3D space. Pedagogical effectiveness is at the heart of online offerings and defines critical parameters for the evaluation of courses. However, learning management systems provide the essential integrative layer for online courses. For online courses to be delivered in the context of learning management systems, we need to look at several additional factors in any evaluation.

The Pedagogy Effectiveness Index (PEI): The pedagogical effectiveness of an online course can be defined as a summation of learning styles, media elements, and interactivity - equally likely and mutually exclusive, a probability distribution tree diagram (see Figure 4) can be shown to have three branches, with sub-branches represented for each axis of the pedagogical learning cube. A PEI can therefore be determined by a summative rule (see Figure 5). The corresponding probability multipliers can be shown in a simple matrix (see Figure 6).

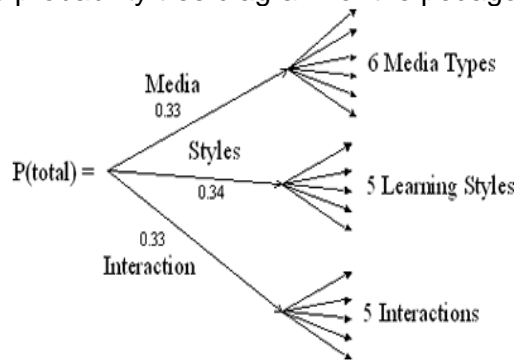Figure 4: The probability tree diagram for the pedagogical learning cube

P(total) =
- Media 0.33 → 6 Media Types
- Styles 0.34 → 5 Learning Styles
- Interaction 0.33 → 5 Interactions

Figure 5: The pedagogy effectiveness index expressed as a summative rule

$$PEI = \sum S_i{}^* p_i + \sum M_j{}^* p_j + \sum I_k{}^* p_k$$

Where S = Style, M = Media, and I = Interaction; the subscripts define the elements' ranges: i = 1 to 5, j = 1 to 6, and k = 1 to 5; and $\sum$ represents summation.

Figure 6: Simple probability distribution matrix

Style	Pi	Media	Pj	Interaction	Pk
Apprenticeship	0.068	Text	0.055	Feedback	0.066
Incidental	0.068	Graphics	0.055	Revision	0.066
Inductive	0.068	Audio	0.055	E-mail	0.066
Deductive	0.068	Video	0.055	Discussion	0.066
Discovery	0.068	Animation	0.055	Bulletin	0.066
		Simulation	0.055		
Total (weighted)	0.34		0.33		0.33

The following are instances of PEI applications for one course offering.

Case 1 - one learning style, one media element, and one interactive element: PEI = 0.068 + 0.055 + 0.066 = 0.189
Case 2 - three learning styles, four media elements, and two interactive elements: PEI = 3*0.068 + 4*0.055 +2*0.066 = 0.556
Case 3 - five learning styles, six media elements, and five interactive elements: PEI = 5*0.068 + 6*0.055 +5*0.066 = 1.0

The above scenario clearly illustrates that the PEI varies from 0 to 1. The probability of the pedagogical effectiveness increases as cognitive opportunity increases with the inclusion of more learning styles, media elements, and interaction. Notice that PEI is based on a simple probability distribution and should be considered an approximate indicator within the bounds of assumptions listed above, specifically relating to the flexible learning approach depicted by the pedagogical learning cube.

Summative rating for online courses: the PEI serves as an indicator of the pedagogical richness of a course. However, successful online course delivery systems are to include content factors; learning factors; delivery support factors; usability factors, and technological factors, with reference to the learning technology standards proposed by IMS, AICC, and SCORM.

Combining PEI with the summative evaluation instrument can be employed as powerful tools (e.g. overall rating = PEI x summative rating score) to evaluate large numbers of online offerings since these criteria often have a clear focus on pedagogically driven design. Use of these tools could guide and motivate online education developers, universities, and training centers toward the successful creation of educational systems.

B. Content Model in the Intelligent Learning Engine

Content delivery is the key of e-learning systems. In his Intelligent Information Delivery System, Quinn indicates that the content model, together with other models provide the information to a central learning engine that uses the current information about the situation, and the information from these models, to pull the appropriate content from a content repository to deliver to the learner (see Figure 2).
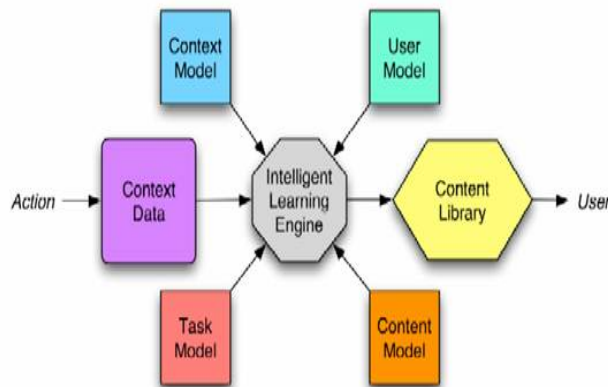

Figure 2. An Intelligent Information Delivery System

The engine uses the models to decide what content would make sense to deliver in this context, and specifies the content to be made available.

Three major categories of information constitute the content model: the different components of information; the metadata used to tag the information with to identify it; the standards that the content conforms to (see Figure 3).
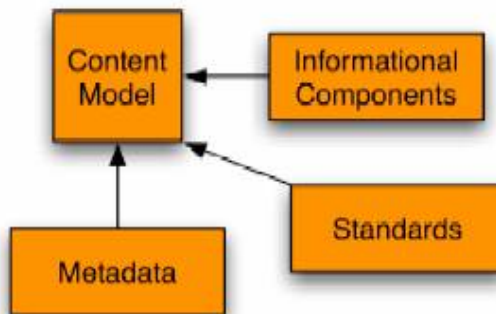

Figure 3. Content Model Components

The Informational Components describe the availability of content types, in terms of their semantic roles. Sets of repair procedures for example, would be of different informational types than customer sales objections job aids. Information concerning the consumers identity and their needs can be employed to build a content model - a structured template detailing what and how to write information that can be transformed through eXtensible Markup Language (XML), and style-sheets into the specific content needed.

Specifications of the standards are important - the Standard Courseware Object Reference Model (SCORM) terms used for learning objects or other standard document formats such as PDF or Flash for instance.

Ideally, the content should be in small granularity, and aggregated into larger chunks but accessible at the smallest level.

C. Content Quality Measures

In order to guarantee better results in e-learning programs, it is necessary to look at content quality measures - the quality of the online education product itself. The National Education Association and Blackboard Inc. examined case studies of six higher education institutions that provide Internet-based degree programs, to ascertain the degree to which various measures of quality identified in previous studies were actually being incorporated into the policies, procedures, and practices of institutions that have distance education learners. A list of twenty-four benchmarks essential to ensuring quality in Internet-based education were grouped under the categories of institutional support, course development, teaching/learning, course structure, student support, faculty support, and evaluation and assessment (The Institute for Higher Education Policy, 2000).

NCREL's (North Central Regional Educational Laboratory) framework builds upon a framework developed by Barbara Means of SRI International. Means identified seven variables that, when present in the classroom, indicate that effective teaching and learning are occurring. These classroom variables are:

- children are engaged in authentic and multidisciplinary tasks
- assessments are based on students' performance of real tasks
- students participate in interactive modes of instruction
- students work collaboratively
- students are grouped heterogeneously
- the teacher is a facilitator in learning
- students learn through exploration
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NCREL reorganized them into a set of eight categories of learning and instruction: vision of learning, tasks, assessment, instruction, learning context, grouping, teacher roles, and student roles – all expanded the definitions to include 26 variables or 26 indicators of engaged learning, summarized in Table 1.

Table 1: Indictors of Engaged Learning

Variable	Indicator of Engaged Learning	Indicator Definition
Vision of Learning	Responsible for learning Strategic Energized by learning Collaborative	Learner involved in setting goals, choosing tasks; has big picture of learning and next steps in mind Learner actively develops repertoire of thinking/learning strategies Learner is not dependent on rewards from others; has a passion for learning Learner develops new ideas and understanding in conversations and work with others
Tasks	Authentic Challenging Multidisciplinary	Pertains to real world, may be addressed to personal interest Difficult enough to be interesting but not totally frustrating, usually sustained Involves integrating disciplines to solve problems and address issues
Assessment	Performance-based Generative Seamless and ongoing Equitable	Involving a performance or demonstration, usually for a real audience and useful purpose Assessments having meaning for learner; maybe produce information, product, service Assessment is part of instruction and vice versa; students learn during assessment Assessment is culture fair
Instructional Model	Interactive Generative	Teacher or technology program responsive to student needs, requests (e.g., menu driven) Instruction oriented to constructing meaning; providing meaningful activities/experiences

Learning Context	Collaborative Knowledge-building Empathetic	Instruction conceptualizes students as part of learning community; activities are collaborative
		Learning experiences set up to bring multiple perspectives to solve problems such that each perspective contributes to shared understanding for all; goes beyond brainstorming
		Learning environment and experiences set up for valuing diversity, multiple perspectives, strengths
Grouping	Heterogeneous Equitable Flexible	Small groups with persons from different ability levels and backgrounds
		Small groups organized so that over time all students have challenging learning tasks/experiences
		Different groups organized for different instructional purposes so each person is a member of different groups; works with different people
Teacher Roles	Facilitator Guide Co-learner/co-investigator	Engages in negotiation, stimulates and monitors discussion and project work but does not control
		Helps students to construct their own meaning by modeling, mediating, explaining when needed, redirecting focus, providing options
		Teacher considers self as learner; willing to take risks to explore areas outside his or her expertise; collaborates with other teachers and practicing professionals

		Students have opportunities to explore new ideas/tools; push the envelope in ideas and research
Student Roles	Explorer Cognitive Apprentice Teacher Producer	Learning is situated in relationship with mentor who coaches students to develop ideas and skills that simulate the role of practicing professionals (i.e., engage in real research)
		Students encouraged to teach others in formal and informal contexts
		Students develop products of real use to themselves and others

III. CASE STUDIES: CDC AND USLEARNING

*A. Scenario-based e-learning model (SEM) at CDC***:**
  Developers at Centers for Disease Control and Prevention *(*CDC) used a framework proposed by Clark Aldrich*,* applied a model that blends characteristics of a simulation with linear e-learning programs. Using a real-world scenario to engage learners, CDC found that developing e-learning programs based on this model required fewer resources than a typical simulation, yet gave the learners a feel as though they were working through a simulation. CDC refers to this model as the scenario-based e-learning model (SEM).
  The development process started with identifying a real-life outbreak investigation that would serve as a solid traditional classroom example. The simulation was designed to enable each learner to work through the case study at his or her own pace without the help of an instructor. The outbreak scenario used in the online simulation was more detailed than that provided in the classroom case study--building in characters, places, and specific timelines. Question formats included multiple-choice, yes/no, fill-in-the-blank, and drag-and-drop activities. Learners could access a variety of support tools, such as hints and reference materials to answer questions.
  Using the notebook style to present the background information and questions offered the users user-friendly and easy access. To support the notebook metaphor, other interface elements, which aren't included in classroom case studies, were placed on the desktop or clipped to the notebook, including snapshots that depict investigation team activities an epidemic curve that graphically illustrates the outbreak and investigation, which also changes as the scenario progresses an investigation outline that corresponds to the six steps of the outbreak investigation and contains a record of the learners progress related items such as press releases and questionnaires.
  To explore more systematically why the linear e-learning approach had the feel of a simulation, CDC examined the program against a framework proposed by Clark Aldrich in Learning Circuits Field Guide to Educational Simulation. The simulation consists of three components: how learners express themselves through input; simulation calculations and branches based on learner input; results and feedback as output that are communicated to learners.
  The CDC course expresses itself through input: The questions posed to the learner mirror those one would wrestle with in an actual investigation. This makes the learner feel

that his or her response to the questions play into the action of the story and have an effect on the end result; the interface includes tools used when investigating a real-life outbreak. Data from the original investigation is available for analysis. The learners feel at times as though they have the ability to directly manipulate input.

Simulation calculations and branches based on input from learners demonstrated a clear learners' control of available options such as remedial lessons, advanced explorations, data analysis activities, and references. Results and feedback as outputs communicated to learners include customized feedback spontaneously and personally, and snapshots of maps, lists and questionnaires through engaging visual drawings.

B. OPM's USALearning system:

OPM provides training services for various federal agencies. Tremendous cost savings, benefits of convenience and availability save NOAA (National Oceanic and Atmospheric Administration) over 90 percent cost using online solution. Between July 23, 2002, and June 30, 2005, USALearning has registered 261,617 users and 221,491 courses completed. The Office of Personnel Management's e-learning initiative and all three of contracting vehicles – the National Technical Information Services, GoLearn and FasTrac have 1.3 million registered users with 955,000 courses completed. [Source: *Office Personnel Management*]

OPM' USALearning Web portal puts professional development in the hands of federal employees, allows them to take classes at their convenience. The Bush administration expects the program to encourage government-wide adoption of e-learning. For nearly 1 million federal workers have taken e-learning training courses in the past five years, USAlearning's enrollment accounts for only about 15 percent of the federal workforce.

The assessment report indicates that students' learning curve, teachers' qualification and productivity outcome are critical factors affecting the success.

Successful learning comes from self-motivation. And often times, a teacher is needed to motivate the learning. Accustomed to classroom environment, the students do not involve the spontaneity necessary for deep learning. However, study indicates that many students find online interaction with instructors stimulating. "Interaction between teachers and students becomes more intense," said, Bill Rust from Gartner, "some students that are too shy to ask a question in a classroom tend to ask more questions online."

E-learning effective depends on the content. How effective the learning will be still depends on the teacher. It is important for the teacher to get training. An instructor who does not understand how e-learning works, sometimes pay more attention to the form than the content. That is a mistake according to experts. "It is all about content," says Jack Kramer at Pathlore Software. "If you don't serve that content up and make it really easy and make people want to come and learn, it's going to fail."

Productivity comes at incentives. Good policies and procedures for earning credits towards promotion upon completing e-learning courses should definitely be in place to insure the productivity outcome.

IV. CONCLUSION

Hall and LeCavalier summarized some firms' economic savings as a result of converting their traditional training delivery methods to e-learning. IBM saved US $200 million in 1999, providing five times the learning at one-third the cost of their previous methods. Using a blend of Web-based (80%) and classroom (20%) instruction, Ernst & Young reduced training costs by 35 percent while improving consistency and scalability. Rockwell Collins reduced training expenditures by 40 percent with only a 25 percent conversion rate to Web-

based training. Many other success stories exist. It is important to note that things are not always bright when we look at some firms with a large expenditure on new e-learning efforts have not received the desired economic advantages.

While generally positive economic benefits are so obvious, other advantages such as convenience, standardized delivery, self-paced learning, and variety of available content, have made e-learning a high priority for many corporations. A survey of 500 training directors (*Online Learning News*) clearly shows the new priorities:

- Sixty percent had an e-learning initiative.
- Eight-six percent had a priority of converting current instructor-led sessions to e-learning.
- Eighty percent will set up or expand knowledge-management programs.
- Seventy-eight percent were developing or enhancing electronic performance support.

ASTD, in its *State of the Industry Report*, noted that the year 2000 marked a new era of growth for e-learning. The events of September 11, 2001, have only accelerated this growth as organizations cut back on business travel, improve their security, and increase their e-learning efforts.

V. REFERENCES

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Author's Biography:

Joseph Bih is an author of many publications through professional journals and technical conferences. His academic and research work with National Science Foundation resulted in grants (Oracle software) that helped upgrading computer lab facilities and software, directly benefited the students he was teaching. He owns

MCSE, CCNA, OCP and other IT certification titles and is actively involved in the industry. His research interests focus on secure networks, information systems management and new technology applications. He is currently a Technology Analyst with the City of Dallas, and an Associate Professor at CCCCD. Joseph Bih is an IEEE Senior Member. He can be reached at jimbih@ieee.org.