**WEB-BASED INSTRUCTION BENCHMARKING REPORT**

**ORNL Training Management**

**Allen White, Training Manager**

**Oak Ridge National Laboratory**

**Melissa Bassett, Performance Improvement Consultant**

**Perot Systems Government Services**

**September 20, 2006**

**ACRONYMS**

3-D Three-dimensional

ACTS Assessment and Commitment Tracking System

ADL Advanced Distributed Learning

ASTD American Society for Training & Development

CCNA Certified Cisco Network Associate

CEO Chief Executive Officer

CMS Content Management System

CSCL Computer Supported Collaborative Learning

DSL Digital Subscriber Line

EPSS Electronic Performance Support System

ERS Electronic Records System

EST E-Service Training

FE Field Engineer

GIF Graphics Interchange Format

HTML Hypertext Markup Language

IDMS Integrated Documents Management System

ILT Instructor-led Training

IPTV Internet Protocol Television

IRIS Image Retrieval Information System

ISD Instructional Systems Design

IT Information Technology

ITS Intelligent Tutoring System

JAVA *an object-oriented programming language*

K Kilobyte

KMS Knowledge Management System

LCMS Learning Content Management System

LMS Learning Management System

LOM Learning Object Model

MCSE Microsoft Certified Systems Engineer

MOO MUD, Object Oriented (see MUD)

MP3 MPEG-1 Audio Layer 3

MUD Multi-user Dimension or Multi-user Domain

MUVEE *video editing software*

ORNL Oak Ridge National Laboratory

PADS Performance Assessment and Development System

PALS Payroll, Absence, and Labor System

PBL Problem-based Learning

PDA Personal Digital Assistant

SAP Systems, Applications, and Products in Data Processing

SBMS Standards Based Management System

SME Subject Matter Expert

SMS Short Message Service

TADDIE Training Analysis, Design, Development, Implementation, and Evaluation

U S United States

VHO Visual Hands-on

VTS Virtual Talk Sessions

WBI Web-based instruction

WID Wireless Information Device

WIIIFM What’s In It for Me

XML Extensible Markup Language

**Activity:**

Web-Based Instruction Benchmark

**ACTS Number and Statement:**

ACTS #8530.56.4. Complete benchmark of two business leaders that develop and deliver web-based instruction for staff training and qualification.

**Purpose:**

This action is intended to identify best practices in the development and delivery of web-based instruction (WBI) for staff training and qualification.

**Objective and Scope:**

In an effort to improve ORNL’s performance in the development and delivery of web-based instruction, identify the best practices in instructional design and development, delivery media, and development tools and resources highlighted by best practice literature and used by leading enterprises to develop and deliver exemplary web-based instruction for staff training and qualification.

**Method(s):**

Conduct reviews of best practices literature, websites, and instructional examples. Profile leading enterprises that develop and deliver exemplary web-based instruction for staff training and qualification. Identify opportunities for improvement and make recommendations to address them.

**TABLE OF CONTENTS**

Executive Summary 8

1. Introduction 12
   1. Background 12
   2. E-Learning in Business 13
2. WBI Reviews 14
   1. ASTD 14
   2. Brandon Hall Research 15
      1. Shortcomings of E-Learning 16
      2. The E-Learning Buffet 18
3. Best Practices in Web-Based Instruction 20
   1. Best Practices Criteria 20
   2. Custom Content 2005 Winning Practices 22
   3. Sampling of Custom Content 2005 Winners 25
      1. Custom Content, Full Course Category - Gold Winners 25
         1. Avon Products with Allen Communication Learning Services 25
         2. Chase Home Finance with VitesseLearning 26
         3. U. S. Air Force Command with Karta Technologies 26
      2. Custom Content, Full Course Category - Silver Winners 27
         1. Professional Development Associates with O/E Learning 27
         2. Roche Diagnostics with Option Six 27
      3. Custom Content, Full Course Category - Bronze Winners 28
         1. TALX with SSE 28
         2. Hibernia National Bank with Noggin Labs 28
      4. Custom Content, Special Strength: Interactivity - Gold Winner 29
         1. Engenio Information Technologies with Allen Interactions 29
      5. Custom Content, Special Strength: Media - Silver Winner 29
         1. U. S. Air Force 1st AF CTSC with Carney 29
      6. Custom Content, Special Strength: Simulation - Gold Winner 30
         1. Microsoft with Convergys Learning Solutions 30
   4. Case Studies: Best Practices at Toyota and Cisco Systems 31
      1. Learner-Driven at the University of Toyota 31
      2. E-Service Training Program at Cisco Systems, 2003 ASTD Excellence in Practice Citation 32
4. E-Learning Experiences 34
   1. Interactivity 34
      1. Interactive Activities 34
      2. Simulations 36
      3. Tours 38
      4. Scenario-Based Learning 38
      5. Games and Puzzles 39
      6. Audio 42
      7. Animations 43
      8. Video-Enhanced Learning 44
      9. Live Presentations and Webinars 45
         1. Intelligent Tutoring Systems 46
   2. Individual and Group Learning 47
      1. Adapted Content 47
      2. Workflow Learning 49
      3. Visualization 49
      4. Collaborative Content 50
      5. Social Networking 53
      6. Problem-Based Learning 54
      7. Project-Based Learning 55
   3. Blended Learning 56
5. Simulations in Detail 58
   1. Why Use Simulations? 59
   2. Simulation Types 59
   3. Benefits of Simulations 60
   4. Disadvantages of Simulations 60
   5. Simulation Development Tools and Off-the-Shelf Simulations 61
   6. Average Development Time by Custom Simulation Developers 63
   7. Performance Data Captured by Simulation Systems 63
   8. Competitive Analyses 64
      1. Custom Simulation Developers 64
      2. Simulation Development Products 65
6. E-Learning Management Systems 65
   1. Content Management System 65
   2. Knowledge Management System 66
   3. Learning Content Management System 66
      1. Learning Object Model 66
   4. Learning Management System 67
7. The Emerging Possibilities of E-Learning 67
8. Conclusions 68
9. Bibliography 71
10. Appendices 74
    1. Appendix A: The E-Learning Industry Glossary of Terms. Learn.com, Inc. Tab A
    2. Appendix B: A Field Guide to Educational Simulations. Clark Aldrich. ASTD. Tab B
    3. Appendix C: A Field Guide to Learning Objects. ASTD and SmartForce. ASTD. Tab C
    4. Appendix D: Web Development Resources and Tools. 74

**EXECUTIVE SUMMARY**

**Background**

The *ORNL Training Management Survey* conducted by Oak Ridge National Laboratory (ORNL) Training Management in September 2005 indicated that web-based instruction (WBI) could be improved by applying sound instructional systems design (ISD) principles and practices and more incorporation of multimedia. In addition, an assessment of current implementation of the Developing Training procedure in the Training Analysis, Design, Development, Implementation, and Evaluation (TADDIE) subject area, conducted in October 2005, indicated similar needs for improving ORNL training courses.

**Purpose and Scope**

Given the current condition of web-based instruction indicated by these two assessments, as well as other informal indicators of the need for performance improvement, ORNL Training Management launched a benchmarking investigation to identify the best practices in the development and delivery of web-based instruction for staff training and qualification. This *Web-Based Instruction Benchmarking Report* contains the results, conclusions, and recommendations revealed by the investigation.

**Method**

Benchmarking identified the best practices in instructional design and development, delivery media, and development tools and resources espoused by best practice literature and websites and used by leading enterprises to develop and deliver exemplary web-based instruction for staff training and qualification.

The two comprehensive sources that provided much of the benchmarking information on which this investigation is based are ASTD (American Society for Training & Development) and Brandon Hall Research. ASTD is the world's largest association dedicated to workplace learning and performance professionals. ASTD provides resources including research, analysis, benchmarking, online information, books, and other publications. ASTD sets the standard for best practices in the profession. Brandon Hall Research provides independent expert advice on the tools of e-learning: learning management system (LMS), learning content management system (LCMS), authoring tools, content providers, and other tools that help organizations develop successful e-learning solutions.

ORNL Training Management purchased three published reports from Brandon Hall Research, which represent thousands of hours of research. One report documents 50 new content formats for e-learning. That report contains over 1,100 hyperlinks to selected examples and online resources, over 500 bibliographic references, and the contact information for over 250 innovative companies and organizations. Each content format includes related terms, a description, its educational application, pros and cons, selected examples, online resources, and a bibliography.

The second report recognizes and highlights 2005’s best examples of content, strategy, and innovative technology in workplace learning. Profiles of 28 online courses include a link to a video sample of the course, the course description, a sampling of the judges’ comments, and the development company’s contact information. The third report provides information about the tools and resources that exist in the simulation-based e-learning market.

**Discoveries**

The characteristics of best practices in WBI are in instructional design; graphics, illustrations, audio, video, animation; simulations; interactivity and motivation; evaluation and assessment; practice and feedback; usability and interface; and aesthetics. The WBI developed by enterprises using best practices:

* emphasizes front-end analysis of performance, audience, and content;
* establishes clear, measurable learning objectives;
* provides motivational content;
* offers ample practice and feedback;
* inserts evaluation matched to objectives throughout the instruction;
* uses state-of-the-art interactivity, technology, and media;
* has an intuitive interface; and
* displays visually-appealing screens.

Enterprises that use best practices in e-learning often partner with e-learning vendors to create WBI. Their WBI development teams consist of staff from both the enterprise and the vendor. Dependent upon course content, length, and simulation sophistication, development teams may range in number from 5 to 20 people who have skills in instructional design, animation, videography, computer programming, and the subject matter. The target populations for best practice enterprises range in number from 100 local employees to hundreds of thousands of employees dispersed worldwide. Their WBI courses range in length from 30 minutes to 15 hours, with development times ranging from 3-8 months or more. Development tools often used include Flash, Photoshop, XML, JAVA, Soundforge, HTML, and Microsoft Word.

Currently, no ORNL training providers have staff dedicated to web-based instruction design and development. ORNL Training Services has one WBI media/technology developer who performs all functions including multimedia creation and application, user interface design, interactivity development, and web-based delivery implementation.

Seventeen (17) of the 50 e-learning approaches reviewed stand out as having immediate and near-future application and usability for ORNL. These approaches describe e-learning experiences that directly relate to interactivity, in particular multimedia and simulations and individual and group avenues for learning, including “blended learning” which is a mix of learning approaches that includes a computer-based component coupled with a “face-to-face” component.

|  |  |
| --- | --- |
| **E-learning Approaches** | |
| ***Simulations and Multimedia*** | ***Individual and Group Learning*** |
| Interactive activities  Simulations  Tours  Scenarios  Games and puzzles  Audio  Animations  Video  Live presentations/webinars | Adapted content  Workflow learning  Visualization  Collaborative content  Social networking  Problem-based  Project-based  Blended learning |

Educational simulations are the preferred learning environment of workers currently 40 years old and under. Simulations come in a variety of forms: large scale flight simulators, role-playing simulations in the classroom, computer-delivered simulations, and high fidelity simulations that can be delivered through cyberspace. A simulation can be very expensive to create, as the average ratio is 245 hours of development for every one hour of finished simulation (245:1). However, when simulations are custom developed using programming and authoring tools, their creation, on average, takes from 750:1 upward to 1300:1.

**Conclusion**

*The Conclusion has been removed due to proprietary information.*

1. **BIBLIOGRAPHY**

Adkins, Sam (2003a) Workflow-based e-learning: next-generation enterprise learning technology. Learning Circuits, Aug. 1, 2003.

Aldrich, Clark (2005) Learning by doing: a comprehensive guide to simulations, computer games, and pedagogy and e-learning and other educational experiences. San Francisco: Pfieffer.

Aldrich, Clark (2005) A field guide to educational simulations. Learning Circuits Series. Alexandria: ASTD.

ASTD and SmartForce (2005) A field guide to learning objects. Learning Circuits Series. Alexandria: ASTD.

ASTD (2004) E-service training program at Cisco Systems, 2003 ASTD excellence in practice citation. Learning Circuits, December 2004.

Bertin, Jacques (1967). Sémiologie Graphique: les diagrammes, les réseaux, les cartes. Paris: La Haye.

Bertin, Jacques (1983) The semiology of graphics. Madison: University of Wisconsin Press.

Billett, Stephen (2001) Participation and continuity at work: A critique of current workplace learning discourses. Paper presented at the Joint Network/SKOPE/TLRP International workshop, November 2001, University College of Northampton.

Canali De Rossi, Luigi (2003a) Contextual collaboration is the future of real-time conferencing technologies. Robin Good Blog, October 25, 2003.

Card, J., Mackinlay, J. and Shneiderman, B. (Eds.) (1999) Readings in information visualization: using vision to think. San Francisco: Morgan Kaufmann, pp. 1-34.

Chapman, B. and brandon-hall.com staff (2005) Online simulations 2005: a knowledgebase of 35+ custom developers, 300+ off-the-shelf simulation courses, and 40+ simulation authoring tools. Brandon Hall Research.

Dalgarno, Barney (2001) Technologies supporting highly interactive learning resources on the web: an analysis. Journal of Interactive Learning Research, 12(2/3), 153-171.

Dochy F., Segers M., Van den Bossche P., and Gijbels D. (2003) Effects of problem-based learning: a meta-analysis. Learning and Instruction, 13(5), October 2003, pp. 533-568.

Dvorak, John (2004) Business networking systems, dead already? PC World, September 20, 2004.

Dziuban, C., Hartman, J., and Moskal, P. (2004) Blended learning. Educause Document.

Elsenheimer (2004) The right ingredients make the best blend. Chief Learning Officer Magazine, July 2004.

Encyclopedia of Educational Technology (2004) Problem-based learning. Encyclopedia of Educational Technology.

Gee, James Paul (2004) What video games have to teach us about learning and literacy. New York: Palgrave Macmillan.

Hegarty, M., Kriz, S., and Cate, C. (2003) The roles of mental animations and external animations in understanding mechanical systems. Cognition and Instruction, 21(4), 325–360.

High, Kamau (2004) How playing power drives lessons home. Financial Times, Sept. 8, 2004, p. 12.

Huk, T., Steinke, M., and Floto, C. (2003) The educational value of cues in computer animations and its dependence on individual learner abilities, proceedings of the ED-Media 2003 Conference, pp. 2658-2661.

Johnson, Steven (2005) Everything bad is good for you: how today’s popular culture is actually making us smarter. New York: Riverhead Books.

Kelly, T., and Nanjiani, N. (2005) Learner-driven at the University of Toyota. Learning Circuits, March 2005.

Kindley, Randall (2002) Scenario-based e-learning: a step beyond traditional e-learning we can all take. Learning Circuits, May 2002.

Laurik, Sven (2002) Using radio shows for training. Creative Approaches to Training Newsletter, April 2002.

Learn.com, Inc. (2006) The e-learning industry glossary of terms. Learn.com, Inc.

Lévy, Pierre (2001) Cyberculture. Minneapolis: University of Minnesota Press.

Linser, R. and Ip, A. (2002) Beyond the current e-learning paradigm: applications of role-play simulations (RPS) - case studies. Paper presented at “E-Learn 2002,” AACE conference, Montréal, October 15-19, 2002.

Lowe, R.K. (2004). Animation and learning: value for money? In R. Atkinson, C. McBeath, D. Jonas-Dwyer & R. Phillips (Eds), Beyond the comfort zone: Proceedings of the 21st ASCILITE Conference (pp. 558-561). Perth, 5-8 December.

Lunce, Les (2004) Computer simulations in distance education. International Journal of Instructional Technology and Distance Learning, 1(10), October 2004.

Mayer, R. and Moreno, R. (2002) Animation as an aid to multimedia learning, Educational Psychology Review, March 2002, vol. 14, no. 1, pp. 87-99.

McGinnis, Michael (2005) Building a successful blended learning strategy. LTI Newsline, July 23.

Millbower, Lenn (2003) The auditory advantage. Learning Circuits, Jan. 13, 2003.

Mödritscher, F., Barrios, V., and Gütl, C. (2004) Enhancement of SCORM to support adaptive e-learning within the scope of the research project AdeLE. Paper presented at E-LEARN 2004, Washington, D.C.

Mohr, G. and Nault, J. (2004) Designing collaborative e-learning for results. Learning Circuits, May 2004.

Morrison, Don (2003) The search for the holy recipe. Online article. http://www.morrisonco.com/downloads/blended\_learning\_holy\_recipe.pdf

Nantel, R., Clarey, J., and Cunningham, A. (2005) Award-winning custom content 2005: description and videos of 28 online courses from the brandon hall excellence in learning awards. Brandon Hall Research.

Nolle, Tom (2005) What’s the real future of video? Business Communications Review, Feb. 2005, 8-9.

Oliver, M. and Trigwell, K. (2005) Can ‘blended learning’ be redeemed? E-Learning, 2(1).

Owen, Martin (2004) An anatomy of games. Bristol, UK:NESTA Futurelab.

Pollard, David (2005) Seven principles of social networking. How to Save the World Blog, July 14, 2005.

Prensky, Marc (2001) Digital game based learning. New York: McGraw-Hill.

Prensky, Marc (2001) Digital natives, digital immigrants. On the Horizon, 9(5), October, 2001, NCB University Press.

Romiszowski, Alexander (2004) How’s the e-learning baby? factors leading to success or failure of an educational technology innovation. Educational Technology, 44(1), January-February, 5-27.

Rossett, A., Douglis, F., and Frazee, R. (2003) Strategies for building blended learning. Learning Circuits, June 30, 2003.

Saveri, A., Rheingold, H. and Vian, K. (2005) Technologies of cooperation. Palo Alto, CA: Institute for the Future.

Schafer, R. Murray (1977) The tuning of the world: the soundscape. New York: Alfred A. Knopf.

Siemens, George (2005) Connectivism: learning as network creation. Elearnspace (blog), Aug. 10.

Sims, Roderick (1997) Interactivity: a forgotten art? Online paper - available at: http://www.gsu.edu/~wwwitr/docs/interact/

Spence, Robert. (2001) Information visualization. Harlow, England: Addison-Wesley.

Swaak, J. & de Jong, T. (2001). Discovery simulations and the assessment of intuitive knowledge. Journal of Computer Assisted Learning, 17, 284-294.

Synteta, Vivian (2002) Project-based e-learning in higher education: the model and the method, the practice and the portal. Presentation to TECFA, University of Geneva, Nov. 25, 2002.

Todoroff, Milana (2003) Personal communication.

Toth, Thomas (2003) Animation – just enough, never too much, Learning Circuits, July 18, 2003.

Tufte, Edward (1990) Envisioning information. Cheshire, CT: Graphics Press.

Tufte, Edward (1997) Visual explanations: images and quantities, evidence and narrative. Cheshire, CT: Graphics Press.

Tufte, Edward (2001) The visual display of quantitative information. 2nd Edition. Cheshire, CT: Graphics Press.

University of Melbourne (2003) Pedagogical designs for e-learning: distributed problem-based learning. METTLEWeb - A Guide to Teaching & Learning with Technology at the University of Melbourne.

Valiathan, Purnima (2002) Blended learning models. Learning Circuits, Aug. 2002.

Ware, Colin. (2004) Information visualization: perception for design. 2nd Ed. Amsterdam: Elsevier.

Woodill, Gary (2005) Emerging e-learning: new approaches to delivering engaging online learning content. Brandon Hall Research.

1. **APPENDICES**
   1. **Appendix A (Tab A)**

The E-Learning Industry Glossary of Terms by Learn.com, Inc.

* 1. **Appendix B (Tab B)**

A Field Guide to Educational Simulations by Clark Aldrich. Published by ASTD.

* 1. **Appendix C (Tab C)**

A Field Guide to Learning Objects by ASTD and SmartForce. Published by ASTD.

* 1. **Appendix D**

**Web Development Resources and Tools**

* [ADE](http://www.umuc.edu/ade/). (Accessibility in Distance Education). The ADE site explains accessibility problems that students with disabilities are likely to encounter in navigating Web-based resources and shows faculty members how they can address and resolve these problems. The site also seeks to provide faculty with information about different types of disabilities, relevant laws, and best accessibility practices.
* [Conferzone](http://www.conferzone.com/). This site is an objective e-conferencing resource that tracks the latest trends and technology in the e-conferencing marketplace. Visitors can sign up for a free monthly e-conferencing e-newsletter and access product reviews, news, whitepapers, tools, and Webcasts.
* [Multimedia Development Tools](http://mime1.marc.gatech.edu/mm_Tools). Maintained by a multimedia research group at Georgia Tech, this collection of checklists, matrices, questionnaires, and more can help guide the process of multimedia analysis, design, management, production, and evaluation.
* [Webmonkey](http://hotwired.lycos.com/webmonkey). An irreverent site for those working with the Web. The site explains new technology and its applications; looks at trends; offers tutorials on HTML and Java; presents articles on authoring, design, and multimedia; and more.
* [Reallybig.com](http://www.reallybig.com/). This is a Web-builder network of links to WYSIWYG editors, animation, icons, counters, fonts, bars, buttons, bullets, clip art, backgrounds, etc.
* [Training Media Review](http://www.tmreview.com/). This site offers objective training product reviews, an opt-in newsletter, tips, and tools for people who evaluate, purchase, and use such business training products as videos, CBT, and online courses.
* [WebAIM](http://www.webaim.org/). Visit this Web accessibility how-to site to ensure that individuals with disabilities can navigate your site. Read about why accessibility is important, view accessibility makeovers, access sample HTML code, and run a simulation to test your site. WebAIM also offers tutorials, a discussion list, articles, and more.
* [ZDNet Developer](http://zdnet.com/devhead). All the tools are here: Cut-and-paste Javascripts, link and HTML checkers, downloads, reviews, news, and Webpage primers. You'll also find articles on standards, multimedia, and usability.