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LEARNING WITHOUT LIMITS

vol. 3

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Emerging Strategies for Effective E-Learning Solutions

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INTRODUCTION

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INTRODUCTION

WHAT IS E-LEARNING?

Most simply defined as "Internet-enabled learning" (Cisco, 1999) it is the ascendant form of electronic learning. But this simple description does not adequately address the tremendous potential of e-learning to transform training and education as we know them. A recent *InformationWeek* survey of 300 information technology executives indicates that online courses are likely to become the standard method of corporate training within the next few years (Mottl, 2000). This volume of *Learning Without Limits* addresses a number of key issues in the rapidly developing world of e-learning, to offer our readers a head start in preparing for the changes ahead.

As the Internet has expanded and e-commerce has mushroomed, we have seen the possibilities for e-learning delivery become increasingly attractive. Industry analyst Brandon Hall found that companies using technology-delivered courses experience a 40-60 percent cost savings over instructor-led education. Perhaps even more important than cost savings are the flexibility, adaptability, and responsiveness of the e-learning approach in a world where learning faster and better may be the only sustainable competitive advantage.

In 1999, the U.S. Department of Labor reported that 85 percent of jobs in this country require education or training beyond high school. The knowledge economy is learning-based, that is, focused on developing and maintaining productive competence. Competency-based learning (CBL) is one very effective basis for e-learning solutions, because of its targeting of crucial skills and prac-

tices that directly contribute to an organization's competitiveness. The competency models at the core of CBL "provide a tool for determining exactly what skills are required to meet the different needs of today and the probable needs of the future" (Lucia & Lepsinger, 1999), an important benefit to learners as well as the organizations in which their skills will be deployed. The articles in this volume of *Learning Without Limits* discuss the role of CBL in e-learning from a number of perspectives.

In her article on e-learning as the site where knowledge management, information technology, and cognitive strategies converge, Ellen Wagner examines the current state of the field and trends pointing the way to future developments, including the advantages of a competency-based approach.

Learning objects are core building blocks of an e-learning solution, and Warren Longmire's article in this volume provides the inside story on writing and developing content for these basic units of e-learning design. Longmire points out that an object-oriented environment permits a number of strategies for developing content and reusing it within meaningful and relevant contexts, including a competency-based approach.

Competency-based learning models benefit from e-learning's ability to deliver content specifically targeted to learner needs. The article by Gena Tuso and Warren Longmire describes a process for reconfiguring existing course content for delivery within a competency-based system. The strategy of breaking courses into component objects not only adapts content for use in competency-based learning plans, but also allows for their re-use in future learning plans.

The final article in this volume, case studies of competency-based e-learning solution implementations at Western Governors University, a competency-based virtual university, and *Kompetansenettet*, an online learning management system implemented for the Confederation of Norwegian Business and Industry, illustrates the tremendous potential of online education and training. The article concludes by reflecting on the issues raised by these two examples, offering a kind of roadmap of the challenges ahead for e-learning solution providers.

E-learning solutions take advantage of the latest developments in information technology as well as best practices in business management and education to provide learning opportunities when and where they are needed. As Informania continues to help shape the evolution of e-learning, *Learning Without Limits* will continue to report on the latest trends and developments in this rapidly expanding field.

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E-LEARNING:

WHERE COGNITIVE STRATEGIES, KNOWLEDGE MANAGEMENT, AND INFORMATION TECHNOLOGY CONVERGE

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E-LEARNING: WHERE COGNITIVE STRATEGIES, KNOWLEDGE MANAGEMENT, AND INFORMATION TECHNOLOGY CONVERGE

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AMONG THE WIDE variety of ways in which information technology is deployed in organizations, electronic learning is emerging as the foundation upon which highly effective technology use in organizations will be achieved. Electronic learning – increasingly called "e-learning" (Trondsen, 1999) – refers to the wide range of technology-mediated learning applications, strategies and tools that give learners the means of increasing their knowledge and improving their skills at times and on terms defined by each individual. Earlier trends in what is increasingly being called the "e-learning space" featured computer-based training (CBT) and computer-managed instruction (CMI), distance learning (especially programs using broadband video distribution via broadcast, coaxial cable or satellite), computer-mediated conferencing and distributed (online) learning. While constituting the biggest share of the e-learning space in the early 1990s, CD-ROM multimedia programs are now outpaced by interactive online learning programs available via the World Wide Web. Today, the World Wide Web and e-learning are inseparable. Web-based interaction and database functionality, combined with e-commerce's transactional capabilities, are the foundations for today's e-learning designs, systems implementations, and material resource production.

What makes e-learning so attractive is its ability to personalize an individual's learning experience. It offers learners the means to proactively pursue information and performance support resources unconstrained by training design or delivery mechanisms. E-learn-

ing tools offer individualized learning programs by profiling each user on such variables as job requirements, personal interests, learning styles, presentation preferences and learning goals. Working in conjunction with reliable, valid and predictive assessments that have been correlated with an individual's learning profile, e-learning management systems help diagnose skill gaps and prescribe professional development activities ensuring the link between learning events and on-the-job practice. Individuals can monitor their own progress and determine what the next step in their professional development should be. Learning resources, ranging from individual objects (stand-alone pieces of information) to online communities of professional practice, professional advisors, and mentors become available when and where those resources are needed by the learner.

Trends in several distinct arenas have and will continue to strongly influence e-learning's growth and evolution. Increasingly complex, competitive workplace needs for information, learning, and performance support are resulting in increased demands for better management of an organization's intellectual assets: its knowledge, its history, its shared experiences, its discoveries, its record of successes and failures, its innovations. Another important trend in e-learning circles results from a combining of the knowledge management focus on the accessibility and reusability of an organization's intellectual assets with the competency–based learning (CBL) approach that links professional development investments to an organization's core competencies. CBL offers a strategy for implementing e-learning solutions that employ competency models as the structure (or "pattern template") for compiling and assembling learning objects in meaningful, relevant ways.

While e-learning converges knowledge management and cognitive strategies, equally essential work defining learning architecture and learning object standards is taking place to ensure the interoperability of learning objects in a variety of learning management systems and settings. This interoperability enabled by open standards is the basis for ensuring that the infrastructure needed to assemble personalized learning plans and programs that meet the learning needs and interests of individuals can be achieved.

Clearly, with e-learning's focus on personalized learning, one should expect that each and every e-learning implementation will offer its own unique solution to the learning, professional development, and performance improvement challenges faced by each organization that ponders the value of adopting e-learning as a competitive strategy. Nevertheless, the convergence of knowledge management, cognitive strategies such as competency-based learning, and information technologies provides a conceptual platform for examining factors likely to influence e-learning implementations in organizations. This paper describes some of the key issues associated

with each of these arenas, in order to clarify key variables affecting the implementation of e-learning initiatives.

KNOWLEDGE MANAGEMENT

According to current reports in strategic business planning and information technology publications (Dempsey, 1999) the knowledge management movement will continue to exert significant impact on e-learning programs in the next 1–3 years (Violino, 1999). Knowledge management refers to the way that organizations generate, communicate and leverage their intellectual assets. The Delphi Group defines knowledge management as "all leveraging of collective wisdom to increase responsiveness and innovation," while the Gartner Group notes that knowledge management is a discipline that promotes an integrated approach to identifying, capturing, evaluating, retrieving, and sharing all of an organizations' information assets (Jennings, 1999). Knowledge management provides organizations with an essential source of competitive advantage in the information economy by capturing, storing, and making accessible its full array of intellectual assets (Harvard Business Review, 1998).

Ironically, while organizational size and complexity have accelerated the need to consciously manage knowledge across time and space, relatively little has been done to increase an individual's personal capacity to absorb information and create new knowledge. In other words, in a world replete with information, there is a significant need for defining cognitive strategies that empower individuals to make better use of the plethora of information resources that are currently available. The central challenge is to better manage the flow of information through and around the "bottlenecks" of personal attention and learning capacity.

Sieloff suggests a number of strategies for facilitating attention management to deal with "information overflow" (Sieloff, 1999):

- *"Know what you don't need to know."* Organizations need to provide personalized solutions for addressing the knowledge needs of individuals without forcing everyone else in the organization to master the same body of information.
- *"Just-in-time, just enough" delivery of knowledge resources reduces the required inventory that an individual must hold in store.* It is no longer necessary to expose individuals to the full array of information resources that may be available. Instead, it is increasingly important to profile the knowledge needs of individuals and to link individuals to the resources they need to quickly build specific capabilities or to respond to specific performance challenges.
- *Use of trusted intermediaries.* The downside of unrestricted,

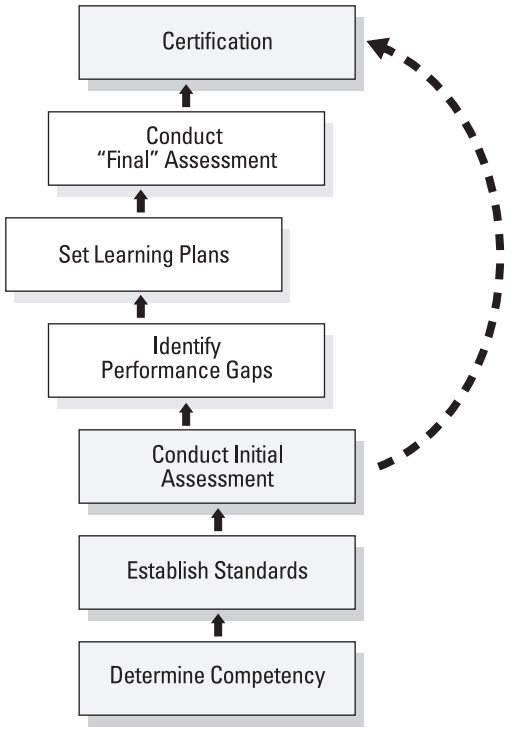
"just-in-time, just-for-me" access to content – whether represented as objects, links or frames – is that it literally destroys the context from which content is drawn. This, in turn, compromises an individual's ability to assign meaning, create associations and link new information with already held knowledge (Ormrod, 1998). It also makes it difficult to filter content for importance (Jonassen & Grabowski, 1993). Technology-mediated intermediaries (such as online advisors, intelligent search tools, adaptive profiling tools, pattern templates, literature summary services and learning management systems) help establish, maintain and monitor frameworks that can define (situational) context. Even so, online communities of practice, knowledge advisors, and learning mentors are playing increasingly important roles in helping individuals to filter and to assign meaning to the array of elements that may be contained in a content object library.

COMPETENCY-BASED LEARNING: A COGNITIVE STRATEGY FOR EFFECTIVE E-LEARNING

Sieloff's personal knowledge-management heuristics (Sieloff, 1999) support the notion of helping individuals target their personalized learning and performance support needs. CBL offers a strategy for achieving the ends of constructing personalized learning plans. CBL links competency assessments with an articulated competency model of the excellent performer. CBL thereby provides the means to benchmark an individual's competencies against specific standards of competency demonstration. When used in combination with a knowledge content distributor, individual learners can then also be linked to learning objects in the form of courses, modules and lessons that will help build capacity in empirically targeted areas.

Competency-based learning emerges from research and best practices dealing with motivation and achievement (McCombs, 1992). It is predicated on the practice of using competency models to articulate performance expectations associated with specific categories of jobs. It works by linking skills and competencies (as described in a competency model) to those learning resources that will help the individual build targeted skills and competencies (e.g., traditional classes, white papers, URL links, videos, CD-ROM/multimedia training and Web-based training). In addition to providing employees the means of determining where skills can be strengthened, CBL also provides a means of securing recognition of skill mastery that has been achieved but not acknowledged through formal training or education.

Illustration 1: A COMPETENCY BASED LEARNING MODEL



Source: Derryberry, A. (1999). The Impact of Technology on Human Performance Technology. Presentation at the Annual Meeting of the International Society for Performance Improvement, March 24, 1999, Long Beach, CA.

Competency-based learning is a strategy for maximizing the effectiveness and impact of training and performance support programs and resources. Where competency models define the scope of skills expected of a high-performing employee, competency-based learning provides the means of linking employees with the essential learning resources they need to build targeted skills.

INFORMATION TECHNOLOGY MEETS INFORMATION SCIENCE: META-DATA STANDARDS FOR LEARNING OBJECTS[1]

There is currently no single set of standards that define the assignment of descriptive attributes (or "metadata tags") to browser-accessible multimedia information objects. Unlike LAN or CD-ROM development environments where closed proprietary protocols tended to guide the design, development and deployment of digital learning resources, developers producing web-enabled content must ensure that open, non-proprietary standards guide the

[1] This section on LALO standards is based on work by Hodgins, W. (1999). Learnativity Learning Standards. Found on www.learnativity.com.

learning resources development process. The desirability of establishing standards for learning architecture and learning objects is, therefore, based upon the goal of defining interoperability standards.

Learning Architecture Learning Objects standards are either learning-focused or technology-focused. Learning-focused standards address issues related to content, metadata and the establishment of a learning management system data model, while architecture standards typically address issues associated with the interoperability of HTML, HTTP, XML, Java and JavaScript.

Vendors, academic research institutions, government agencies and industry consortia have been collaborating to ensure that web-enabled learning technology products can interoperate with one another. There is a shared expectation that the various initiatives involved in defining learning technology standards will negotiate a convergent solution rather than adhering to a single organization's proprietary approach. Several of the organizations involved in defining learning architecture and learning object standards are briefly described in the following paragraphs:

- *The Aviation Industry CBT Committee (AICC)* is an open forum of training professionals that develops guidelines for interoperable learning technology. During the past five years the AICC's Computer-Managed Instruction (CMI) specification has become established as the most comprehensive CMI specification supported by products and in global operational use. AICC CMI defines the tracking data exchanged between management systems and interactive lessons. It also defines an interchange format for course structure so that entire courses can be exchanged between management systems made by different vendors. For more information please refer to http://www.aicc.org
- *The Instructional Management Systems Project (IMS),* formerly a project with EDUCAUSE, is a consortium of higher educational institutions and technology vendors who are working together to define a comprehensive architecture for online learning. The architecture encompasses platform independent interfaces for metadata, aggregated content, management services, user profiles and external services such as databases. The IMS architecture anticipates the widespread availability of emerging technologies such as XML and provides an excellent vision for the future of online learning. For more information please refer to http://www.imsproject.org
- *The World Wide Web Consortium (W3C)* charts the future course of general purpose Web technologies such as HTML and XML.

While the W3C does not focus on learning, it does define basic technologies that are assumed by many learning technology specifications. For more information please refer to http://www.w3.org

- *The Computer Education Management Association (CEdMA)* is a forum whose members are education managers from companies manufacturing hardware or software products. CEdMA provides a forum to discuss training and business issues of common interest to technology vendors. It is well positioned to accelerate vendor awareness and adoption of learning technology standards. For more information please refer to http://www.cedma.org

- *The Advanced Distributed Learning (ADL) initiative* fosters collaborations between government, academia and industry to accelerate the advent of effective online learning. The initiative began in November 1997 under the aegis of the U.S. Department of Defense and White House Office of Science and Technology Policy. For more information please refer to http://www.adlnet.org

- *The IEEE Learning Technology Standards Committee (IEEE LTSC)* is an open, accredited standards body tasked to develop "real," de jure learning technology standards. Consortia such as IMS and the AICC increasingly acknowledge the IEEE LTSC as the single forum for turning specifications into standards.

  Both the AICC and IMS initiatives are furthering their goals in the IEEE LTSC. The AICC has submitted its CMI specification and IMS has jointly submitted a metadata specification with the European ARIADNE Project. For more information please refer to http://ltsc.ieee.org

- *The Alliance of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE)* is a project pertaining to the "Telematics for Education and Training" sector of the Fourth Framework Program for Research and Development of the European Union. Since December 1997, ARIADNE has been involved in standardization activities performed under the auspices of the IEEE LTSC Committee. In this context, ARIADNE has agreed to collaborate with the EDUCAUSE IMS Project, in order to arrive at a widely acceptable Educational Metadata set as soon as possible. For more information please refer to http://ariadne.unil.ch

EFFECTIVE E-LEARNING IMPLEMENTATIONS

The arenas of knowledge management, competency-based learning, and information technology will, of course, continue to evolve, but some features of their convergence in effective e-learning implementations are beginning to emerge. Hodgins (1999) has noted that, for knowledge management systems to realize their full power, three essential system components must be in place. These elements include:

- *Learning objects,* offering access to content at a granular level that typically maps to a single learning objective. Learning objects (also known by other names, including *content objects, knowledge objects, reusable information objects,* and *reusable learning objects*) are stand-alone pieces of information that are reusable in multiple contexts, depending on the needs of the individual user.
- *Metadata,* descriptive indexing labels, or "tags", that articulate attributes defining a variety of characteristics about each object of content. Metadata facilitates searching, management, and linking of granules of content. Metadata enables users and authors of content to search and retrieve and assemble content objects according to parameters defined by users.
- *Pattern templates,* providing a data structure based upon specific arrays of metadata attributes. The selection and compilation of metadata attributes into stand-alone "metafiles" contextualizes learning objects according to variables defined by users. Pattern templates enhance the meaningfulness of reusable learning objects much in the same way that sentences offer a structure for assembling words to extend and expand meaning at a higher order of thinking.

COMPETENCY MODELS

Competency models may offer a solution for constructing pattern templates based upon "best practices" in on-the-job or performance improvement settings. A competency model is a collection of related descriptions of the knowledge, skills, abilities and behaviors of an excellent performer. While competency models have offered a useful means of defining employee attributes for organizations for the past 30 years, competency models may extend well beyond their original recruitment and selection applications as knowledge management methods and tools become increasingly commonplace. By identifying the attributes of outstanding employees in given job roles, competency-based criteria can be selected that establish performance standards for reviewing the performance and capacity of existing employees. Competency models also provide a "best prac-

tices" template to assist in assembling reusable information and learning objects that support both individualized learning needs and cost-effective, targeted professional development needs of the organization. As reusable information objects (RIOs) and reusable learning objects (RLOs) become increasingly widespread as the building blocks for constructing highly personalized learning resources, competency models can serve as the basis for establishing the framework upon which RIOs and RLOs can be contexualized and repurposed.

Given competency models, organizations can assess the competencies of existing employees by benchmarking employee capabilities against the standards of excellent performance as articulated in the competency model. Competency models provide the means for aligning human resources policies with the long term strategic planning as well as ongoing, periodic reassessment and recalibration of the organization's human resources. Human resources planning becomes the occasion to identify and capitalize on strategic opportunities.

Attributes expressed in a competency model for a particular job or performance category can also provide employees with a mechanism for converting the description of attributes to expressions of essential skill areas. On this basis, employees are able to compare their skills with those expected of the outstanding performer. Thus, competency models support the employees' efforts to create professional development strategies. On an organizational level, this has the happy result of raising the overall level of industry skills and competencies.

In summary, competency models benefit organizations and employees because they:

- Allow for the development of strategic plans that are based upon an organization's core competencies
- Help organizations drive strategic change by modeling the organizations' success competency profile
- Allow organizations to set training, hiring, and policy goals to meet the human resources requirements of the strategic vision
- Help clarify job and work expectations for employees and their managers
- Help organizations manage to strategic plan by allowing managers to monitor the essential performance requirements of a given job at any given time
- Support self-improvement by giving employees benchmarks to see how they measure up to company expectations
- Provide a "pattern template" for assembling reusable information and learning objects that respond to specific learning needs of individuals and organizations.

LEARNING OBJECTIVES STRUCTURES

In spite of the advantages of CBL models for e-learning solutions, there will be situations in which a knowledge-based approach is required. That is why Informania has developed an approach that allows for the same kind of flexible intervention in knowledge-based learning as we have in the performance-based competency model. This common framework is called a "Learning Objectives Structure" (LOS). The LOS guides the assembly of relevant objects into a coherent yet flexible learning experience, whether the objectives in the structure relate to a competency model or to a more traditional knowledge-oriented learning plan. In addition to flexibility with regard to various cognitive strategies, our LOS will be adaptable to whatever technical standards for knowledge management emerge from the initiatives currently before the IEEE LTSC.

CONCLUSION

The "just-in-time, just-for-me" flexibility e-learning offers learners – and, by extension, the organizations that benefit from their learning – is in the process of transforming education and training today. This article examined the convergence of forces that made this flexibility possible, resulting in an unprecedented opportunity for widespread personalized learning to be delivered to individual desktops in the form we call "e-learning solutions."

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CONTENT AND CONTEXT: DESIGNING AND DEVELOPING LEARNING OBJECTS

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CONTENT AND CONTEXT: DESIGNING AND DEVELOPING LEARNING OBJECTS

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DESIGNERS AND DEVELOPERS of electronic learning today are being presented with a new content development landscape. Learning technology standards organizations[1] are quickly moving towards open and industry-wide standards for learning objects (learning objects are stand-alone pieces of information that are reusable in multiple contexts). Soon we may see their efforts converge into uniform object standards that truly enable the capabilities of learning systems and content that will benefit learning developers as well as learners: interoperability, accessibility, reusability, discoverability, extensibility, affordability, and manageability (Learnativity, 1998). As learning content developers look at these initiatives that focus on packaging, identifying and exchanging content, they are bound to ask, "But what does this mean for me? How will my work be different in the future?" This article describes some of the challenges and opportunities that reusable learning objects (RLOs) present to content developers as the object-oriented approach is adopted in more and more learning interventions. Strategies are discussed for planning, designing, and developing learning object content and for contextualizing content.

1 Organizations working on learning object standards and specifications include IEEE, AICC, IMS, CedMA, ADL, ARIADNE, LOMG, and the MMI Workshop.

WHY DEVELOP CONTENT AS LEARNING OBJECTS?

Most electronic learning content is currently developed for a specific purpose such as a course or a situational performance intervention, and not for the sake of populating an objectbase (a collection of learning objects, typically contained or referenced in a relational database). However, as object content increasingly becomes a valuable commodity, we will see more content developed specifically to be deployed as learning objects in multiple settings. Why would designers wish to add a layer of complexity to their work by including object capability in their design? The reason is that their content gains a "value-add" that in most cases will pay off many times over (in terms of costs, development time, and learning effectiveness). The object approach can satisfy both immediate learning needs – such as a knowledge-based or skills-based course – and current and future learning needs that are not course-based. There are several arguments for designing and developing material to be reused as learning objects in other contexts, including the following:

- *Flexibility.* If material is designed to be used in multiple contexts, it can be reused much more easily than material that has to be rewritten for each new context. It's much harder to uncouple an object from the context of its parent course and then re-contextualize it, than it is to contextualize as part of design and development.
- *Ease of updates, searches, and content management.* Metadata tags[2] facilitate rapid updating, searching, and management of content by filtering and selecting only the relevant content for a given purpose.
- *Customization.* When individual or organizational needs require customization of content, the learning object approach facilitates a "just-in-time" approach to customization. Modular learning objects maximize the potential of software that personalizes content by permitting the delivery and recombination of material at the level of granularity desired.
- *Situational specifications that interoperate with industry standards.* The object approach allows organizations to set specifications regarding the design, development and presentation of learning objects based on organizational needs, while retaining interoperability with other learning systems and contexts.
- *Facilitation of competency-based learning.* Competency-based

[2] Metadata tags are descriptors that are attached to a learning object. These descriptors, or values, can indicate any number of attributes for the object.

approaches to learning focus on the intersection of skills, knowledge and attitudes within the rubric of core competency models rather than the course model. While this approach has gained a great deal of interest among employers and educators, a perennial challenge in implementing competency-based learning is the lack of appropriate content that is sufficiently modular to be truly adaptive. The tagging of granular learning objects allow for an adaptive competency-based approach by matching object metadata with individual competency gaps.

- *Increased value of content.* From a business standpoint, the value of content is increased every time it is reused. This is reflected not only in the costs saved by avoiding new design and development time, but also in the possibility of selling content objects or providing them to partners in more than one context.

IDEAL ATTRIBUTES OF RLO CONTENT

There are two requisite components of a learning object: the object content, and its metadata tag. Descriptions and keywords provide some degree of context, yet ideally there are additional contextualizing options. As software developers race to produce authoring and tagging tools, it remains to be seen what various context-enriching options will be available. The most desirable tools will permit scalable contextualization, so that learners can control the extent to which context is presented with content.

In an environment in which context is scalable and adaptive, the ideal RLO content is:

- Modular, free-standing, and transportable among applications and environments
- Non-sequential
- Able to satisfy a single learning objective
- Accessible to broad audiences (such that it can be adapted to be relevant to audiences beyond the original target audience)
- Coherent and unitary within a predetermined schema such that a limited number of metatags can capture the main idea or essence of the content
- Not embedded within a "look" so that it can be repurposed within a different visual schema without losing the essential value or meaning of the text, data, or images.

CREATING SPECIFICATIONS

When learning content is created both for immediate purposes and for use as RLOs, designers and developers must enlist a sort of

double vision. This double vision entails conceptualizing content as part of a larger whole (such as a course), and as stand-alone information at the desired level of granularity. These do not have to be conflicting activities, though to accomplish both successfully and efficiently requires thoughtful planning. RLO content needs to be grounded in solid instructional design, so the new landscape of learning objects will welcome the efforts of experienced instructional designers.

The key planning activity in the design phase is the creation and articulation of specifications for content development. Specifications need to cover the range of development concerns, including technologies to be used, document templates, markup definitions (for example, the Document Type Definition in SGML-based software), editorial standards, modularity requirements, structural rules, and the level of granularity desired (e.g. from the course all the way down to a very small object such as a graph or a table). If these components are not decided in advance, developers may waste time re-creating content to meet the needs of either the project at hand or reusability requirements.

Once specifications are established, they can be re-used, or tailored for individual projects. Some broad content development specifications that have been used in learning-object templates at Informania include:

- *Consistent use of language and terminology within a topic area.* Consistent terminology allows discrete objects to be easily disassembled and reassembled, retaining consistent meanings that are reflected in contextualizing reference documents. For example, in an objectized course on e-commerce, the decision was made to consistently refer to online shoppers as "consumers" instead of using "customers" and "consumers" interchangeably. This helps prevent potential learner confusion in the event of adaptive re-assembly of the lessons.

- *Presentation of information in easily accessible and comprehensible formats.* For example, detailed or technical information may be better presented in tables, bullets, or columns rather than in sentences and paragraphs.

- *Presentation of information for on-screen consumption.* As RLOs will most frequently be accessed and used on-screen, standard techniques of Web content design should be followed. For example, dense text should be chunked into smaller units, with frequent use of headings and wayfinding text.

- *Non-sequentiality of information across objects.* Information needs to be free-standing and easily adapted to multiple contexts. This means there should be no backward-forward referencing across objects (such as references to previous chapters). There are a

number of techniques for handling this requirement, such as the use of mini-summaries that provide just enough context to introduce a concept, and the use of tagged context "wrappers." Of course, within an object it may be necessary to present information sequentially. For this reason it is necessary to determine the granularity or "size" of the smallest object before beginning development.

- *Uniformity of editorial tone across objects.* Unless an object is specifically tagged as an introduction or conclusion, it should not have the editorial tone of an "opening" or a "conclusion."
- *Use of keywords in searchable elements.* If certain keywords will be used to link specific content areas, searching capabilities will be improved by actually using the keywords in titles and searchable elements such as tables of content and indexes.
- *Use of language and content appropriate for a broad audience.* For an object to be reused with minimal manual customization, the content needs to be appropriate for a broad audience. Regional terminology or audience-specific humor may not be appropriate. If colorful language or humor are desired when delivering the object as part of an engaging learning experience, these components are better added at the contextual level (and can be part of the personalization of learning content).

CHALLENGES AND OPPORTUNITIES FOR DEVELOPERS OF CONTENT

In some ways, developing in this environment goes against the hallmarks of good technical or expository writing that developers and writers learned in writing class. Object content doesn't "flow" across objects either as an argument or as cumulative knowledge. Within the object itself, colorful writing should be avoided. Yet one might argue that there is an art – or at least a distinct skill – to writing within such an environment. Complicated, nuanced, or chronological content present challenges that need to negotiated either by the writer or via template-based solutions. Likewise, a writer needs to be able to reference information in other objects without violating modularity, but also without making the learning experience tedious for learners who are accessing multiple objects (as in a course).

Alongside these challenges, there are also numerous opportunities for content developers in an object-oriented environment. The greatest benefit for developers is the reusability of existing content. With appropriate tagging and knowledge management practices, RLOs can reduce time spent researching and accessing content, thus facilitating rapid creation of new electronic learning content. A positive byproduct of the object approach is that emphasis on planning

and modularity requires the purpose and main idea of content to be very clear before beginning development, thus reducing the need for rethinking of content.

CREATING CONTEXT

The key for deploying learning objects effectively is to provide ways for the learner to contextualize the information. Without context, learning objects can be confusing, misleading, or utterly meaningless. Context is the second path for personalization of objects (after adaptive selection of appropriate objects based on individual needs). Clearly, providing the original context of an object will often be inappropriate (and in many cases defeats the adaptive purposes of breaking instructional material down into smaller objects). Yet how much context is enough? Context can be infinite, from the most immediate uses for information to the social and economic conditions for the production of that information. Perhaps a better question would be: how can context be scalable in expanse and type, so that the learner can decide how much is needed?

PRESCRIPTIVE CONTEXT VS. LEARNER CONSTRUCTION OF CONTEXT

While information is always produced within a specific set of circumstances, it is a mistake to construe the context of information as necessarily static and unchanging. This view does not reflect the psychological processes through which individual learners make sense of information in a changing world. While it is frequently valuable to capture the original context of learning material and make it available to learners, a dynamic learning environment should also encourage individuals to participate in the active construction of meaning and context.

Constructivist theories and active learning theories have helped educators understand the way learners actively create meaning by exploring, experimenting, testing, and applying knowledge in self-directed and collaborative fashions (rather than in a pre-determined course of study). Use of learning objects will empower online learners in unprecedented ways, by enabling them to participate more actively in the contextualization of information. In this paradigm, context is not something that is simply provided to a learner. Instead, contextual information has two functions: to orient objects to their original or most likely contexts, and to provide cues for learners to apply their own meanings and contexts to the information.

CONTEXT STRATEGIES

There are many ways to enable contextualization of learning objects, depending on the systems and technologies available, and on the extent to which the learning content needs to be adapted to individual needs. The following are some possible approaches:

- *Tailored Wrappers.* Context "wrappers" consist of information that is associated with a learning object. One object can have multiple wrappers, each providing a different way of contextualizing the object. In a learning environment, an instructional designer might generate multiple context wrappers (some using audience-specific data). When a learner accesses the RLO, the context of the object will be a function of the correlation between learner attributes and content object attributes (described with metadata tags).

- *Tailored Context Frames.* As noted earlier, ideal RLO content is not only addressed to one small audience. However, on the level of context, an object can be personalized with such techniques as humor, visual or linguistic themes, or explanations that relate it to a specific body of knowledge. Object framing matter and instructional activities can be specific to an organization or group of people, as long as they can be divorced from the object. Context frames can be designed to match learner profile characteristics such as interests, needs, level, knowledge and performance gaps. Technologically, such frames can be very simple or very complex. A very simple way of thinking of context frames is, literally, through the use of browser frames. In one frame, for example, can be learning object content (text, graphics or multimedia content) that is relatively unchanging from one application to the next. In the other frame can be contextual information that is tailored to the individual based on the individual's profile, similar to a sidebar or marginalia. Depending on the environment used to deliver the content, the delivery mechanism can be much more sophisticated – for example, the context frame could respond to keywords in the metadata wrapper. Context frames can also respond to a learner's purpose in accessing an object. If the object is part of a larger learning plan, it might be framed using an ongoing example or situation throughout the learning experience. On the other hand, if the object is being accessed by itself for performance support, it might be framed with sidebar links to more details, examples, and other online resources.

- *Adding Context Links to Objects.* If a development environment allows for editing of learning objects themselves (not just metadata wrappers or context frames), then links (such as hyperlinks) can be added to context within the learning object. This way, developers may spend very little time changing the object, and provide links to context that that the learner can choose to follow or not. The linked context can be updated and can provide context for multiple objects.
- *Pattern Templates.* Pattern templates provide a data structure based on metadata attributes defined by users. Technically, "pattern templates" are data structures used for programming. For learners (and instructional designers), these data structures translate into opportunities to contextualize information in a variety of meaningful ways according to variables defined by users. One application of pattern templates is the use of competency models to contextualize learning objects in relation to abilities, knowledge, and attributes of excellent performers in an organization (a performance-based approach to using learning objects). For example, a learning object that pertains to time management can be contextualized within a pattern template that positions the object within a hierarchy of higher-level competencies (such as self-management) and lower-level skills (such as using organizing tools).

CONCLUSION

The establishment of industry-wide standards for learning objects will create incentives for software providers to produce new tools for developing and delivering learning objects. Whatever development environment and tools are used, sound instructional design will remain important both for customized development and for template-based development. The combination of thoughtful planning with intelligent deployment of advanced authoring tools will result in a myriad of benefits for both content producers and learners. The most successful learning object delivery systems will be able to provide not only learning object content, but relevant and meaningful context as well.

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COMPETENCY-BASED SYSTEMS AND THE DELIVERY OF LEARNING CONTENT

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COMPETENCY-BASED SYSTEMS AND THE DELIVERY OF LEARNING CONTENT

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Web-enabled e-learning environments represent a dramatic expansion of the possibilities for implementing effective competency-based learning. Competency-based approaches have been used in training and performance improvement interventions for several decades; however, course-centric delivery methods have prevented the full realization of the potentials of competency-based learning systems. This is because competency-based systems work best with a high degree of flexibility and personalization. Web-enabled e-learning environments allow for creation of more highly customized and flexible competency-based learning plans than has been possible in the past.

There are many definitions of "competency" that circulate in the business, training, and education worlds. In a general sense, competency is the qualification and ability to perform a task or job effectively. A more technical and widely used articulation of competencies describes a competency as "a cluster of related knowledge, skills, and attitudes that affects a major part of one's job (a role or responsibility), that correlates with performance on the job, that can be measured against well-accepted standards, and that can be improved via training and development" (Parry, 1996). The key elements of this definition for e-learning implementations are performance, measurement, and improvement.

Competency-based learning is contrasted with knowledge-based, course-centric learning in the following ways:

- You learn only what you personally need to learn, not what a

course designer thought you should learn.

- Your learning plan is designed to address knowledge or performance gaps, so you don't have to re-learn material that you already know.

For learners, the appeal of this model is its flexibility and customization for the individual. For organizations, this model is appealing because it offers learning outcomes that are measured in terms of competent performance. Electronic delivery of modularized, free-standing learning objects will enable truly adaptive, competency-based learning.

One of the biggest challenges associated with this approach is the necessity of matching existing learning content to the competencies within a competency model. The problem is that most existing content is still in the form of courses, instead of in smaller instructional units that can be accessed independently to address individual learning needs and performance gaps. There are two significant hurdles in overcoming this challenge: accessing third-party proprietary content, and reconfiguring content to adapt to a competency model.

The first challenge is due to the fact that much course content is proprietary and belongs to a third-party vendor or educational institution. This requires working with vendors to be able to break their course material down and access it via an integrated course player, a training management system, or some other medium. The vendor or training provider needs to be able to track use of content as digital, individual objects. And of course this means developing a pricing scheme that prices objects instead of (or in addition to) full courses.

The second challenge involves both instructional design and technology concerns in reconfiguring content to adapt to a competency model. Designers need to be able to break learning content down to a pre-specified level of granularity, map it to competency model, and tag it for delivery within an e-learning environment. This article focuses on this second challenge. It offers a process model for reconfiguring courseware to deliver within a competency-based system, and provides suggestions on how to repurpose knowledge-based content for electronic delivery within a performance-based schema.

PROCESS MODEL

The process model below represents an outline of the major stages necessary for reconfiguration of existing course content for electronic delivery within a competency-based system:

1. Develop/identify an appropriate competency model

2. Identify and evaluate existing content for its correlation to the competency model, and for its usefulness within a performance-based paradigm

3. Chunk and tag learning objects (stand-alone pieces of information that are reusable in multiple contexts, depending on the needs of the individual user)

4. Assemble learning objects for delivery within an objectbase (a collection of learning objects, typically contained or referenced in a relational database) that is accessed using metadata pertaining to individual learning/performance needs

In the following sections of this article, each stage is described in greater detail.

DEVELOPING COMPETENCY MODELS

The first step in establishing a competency-based system is to define and validate appropriate competency models for the desired learning areas. A competency model, as defined by Lucia and Lepsinger, "describes the particular combination of knowledge, skills, and characteristics needed to effectively perform a role in an organization" (Lucia & Lepsinger, 1999). Competency models usually follow a hierarchical structure, with high-level competency areas narrowing into increasingly specific or specialized sets of skills, knowledge and attitudes. One model used on a recent project at Informania deployed the following hierarchy:

– Job category
  – Skill area
    – Competency
      – Performance objective

A range of methodologies can be used to create competency models, including consulting professional publications, live observations of top performers, and interviews with subject matter experts (SMEs). As there are a number of commercially available, off-the-shelf competency models, it is not always necessary to develop a competency model from scratch. It is, however, important to ensure that any model developed by a third party is validated by SMEs and by the top performers whose performance the model is intended to describe.

EVALUATING CONTENT

Once a competency model has been established, existing learning content needs to be assessed for its appropriateness for deployment with the competency-based system. There are two main eval-

uation criteria:

- *How well does the learning material correlate with the competency model?*

  Ideally, learning content would correlate directly with the competency model, or at least with discrete portions of the model. In reality, very little learning content (especially that in the form of courseware) will match a newly-developed competency model. Therefore, it is important to assess the extent to which existing material will need to be reconfigured to correlate more directly with discrete portions of a competency model. Those items that correlate more closely will probably be more attractive candidates for deployment within the competency-based learning program. In some cases, a relevant learning area that is not part of the competency model appears in multiple courses. This may be an indicator of a need to re-validate the competency model.

- *Does the learning material contain performance-based content?*

  In many cases, existing instructional material is only knowledge-based. It doesn't allow the learners to practice competencies or the hands-on learning activities that are often necessary to become truly competent. Knowledge-based learning material may still be valuable for a competency-based system if it includes content that is useful background information for performance-based learning.

CREATING LEARNING OBJECTS: CHUNKING AND TAGGING OF CONTENT

Once appropriate content has been identified, it needs to be broken down into learning objects: modular units small enough to map to specific components of the competency model. These objects are then given metadata tags that describe the areas of the competency model that they address. These tags can also include other information that facilitate personalization, such as relative difficulty of the learning object, or appropriate audience characteristics such as job titles most likely to correlate with the object's content.

As this stage is performed, there will be many questions that depend on the learning needs of the target audience and the nature of the content. For example, how small should each chunk be? How many and what kinds of tags should each object have at a minimum? There are a number of products on the market—or soon to reach market—that will assist in tagging learning objects in a general, standardized way. There also may be occasions when a competency-based intervention requires a more customized approach to tagging and chunking. This can be automated to some extent,

though thoughtful instructional design will need to underlie any automation schema.

Currently, most course providers do not offer the option to purchase course segments as discrete learning objects, though in the future the learning object market is expected to provide greater incentives to providers for offering instructional material in smaller units. When appropriate content cannot be located for delivery, then of course it may be necessary to develop learning-object content.

ASSEMBLY FOR ELECTRONIC DELIVERY

The technological portion of a competency-based learning system may vary tremendously from one organization or project to another. Technological decisions will be influenced by such variables as the nature of existing database assets and systems, and whether online content will be accessed via a browser over the web, or through another type of interface. Generally, the objectbase that houses the learning objects will need to be a fairly sophisticated relational database that is flexible and easy for instructional designers to access so they can add, delete, or edit content and tags. A key point to remember is that objects will need to be accessible for multiple purposes, so they should be easy to retrieve via any one of their multiple tags.

KNOWLEDGE-BASED CONTENT FOR A PERFORMANCE-BASED SYSTEM

In a competency-based system, the goal is not simply to deliver small chunks of knowledge that relate topically to an area of the competency model. Rather, the learning objects should ultimately work to improve actual performance (which in practice is a combination of knowledge with skills and attitudes). Some existing learning material is designed to be performance-based; however, much existing courseware is still knowledge-based.

There are ways to maximize the value of knowledge-based content, even within a competency-based schema. Knowledge-oriented objects can be combined with performance-based objects such as hands-on activities, simulations, and action plans for workplace implementation of online learning. This could mean developing system guidelines that require an approved learning plan to consist of both knowledge-based and performance-based objects.

Additionally, the competency model can provide performance-based context for knowledge-based content. A competency model can help learners to place the content within the rubric of effective practices and behaviors, and to strategize ways to implement the learning in the workplace.

CONCLUSION

For existing course content to be successfully deployed within a competency-based system, it usually needs to be reconfigured. The key to this process is the ability to break material down into smaller instructional components that are tagged as individual learning objects. If objects are organized and tagged in a meaningful fashion and housed in a flexible system, they may be recombined to form a truly customized, adaptive, competency-based learning environment.

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COMPETENCY-BASED E-LEARNING IN PRACTICE: TWO CASE STUDIES

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COMPETENCY-BASED E-LEARNING IN PRACTICE: TWO CASE STUDIES

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THE FOLLOWING two case studies illustrate how competency based e-learning strategies are being used to provide an organizational schema for implementing technology-mediated learning programs. One case study examines the designs underlying a competency-based virtual university based in the United States, while the other case study looks at a national technology-based professional development initiative in Norway.

WESTERN GOVERNORS UNIVERSITY

The Western Governors University (a U.S.-based virtual university) uses objective, reflective and portfolio-based assessments of competency as the basis for granting degrees and certifications of program completion. Courses and courseware from partner institutions are among the many means at a student's disposal for preparing to complete competency assessments. However, courses completed as part of a student's "academic action plan" are used only as a means of helping students master the knowledge, skills and attitudes represented among the battery of degree/program assessments. WGU degrees do not make use of academic credit as a measure of program completion. At WGU, degrees and certificates are awarded on the basis of successfully completing a battery of objective, critical thinking, and portfolio-based competency assessments across the array of topic domains that have been identified for each specific degree and/or certification program.

The vision of a virtual university based upon documenting stu-

dent achievement of competency was first articulated in June 1995 at a meeting of the (U.S.) Western Governors' Association. At that meeting, the governors of 15 Western states posited that collaboration among institutions of higher learning, industry, and government could produce a new model of higher education. This new model of higher education would combine advances in technology (e.g. virtual private networks; the World Wide Web), technology-mediated teaching and learning (e.g., distance learning; distributed learning; online communities) and research in the arena of competency-based learning to create an alternative to traditional "brick and mortar," credit-based institutions. This new model of higher education was viewed as a solution for providing the Western states with a sufficient number of individuals with skills needed to fill current and future job vacancies in a rapidly changing workplace.

While reaffirming their commitment to traditional colleges and universities, the governors were concerned that traditional institutions were increasingly unable to meet the growing demands for well-qualified, competent job candidates. According to some estimates (e.g., the American Society for Training and Development, the Kellogg Foundation, the Western Interstate Commission on Higher Education, the Gartner Group), many of the jobs in existence 15 years from now have not yet been invented. There is, and will continue to be, a tremendous need for lifelong learning and job training that focuses on developing competencies in high-demand and rapidly changing fields of endeavor.

The governors were also interested in providing alternatives for working adults and non-traditional students who were interested in improving their knowledge and skills in newly-emerging disciplines. The governors understood the value of making technology-mediated education alternatives available for working adults and non-traditional students that minimize disruption of work and personal obligations.

At the core of the governors' vision was the philosophy that learning occurs throughout life; it is not limited to what is learned in the traditional classroom. WGU degrees and certificates were designed as a reflection of what learners actually know and can demonstrate, rather than on course requirements and credits. In WGU's competency-based learning design, students earn their degrees and certifications by demonstrating knowledge, skills, attitudes and behaviors expected of excellent performers in a given discipline of study and practice. This is accomplished by means of successfully completing a battery of domain-specific assessments that reflect the full range of knowledge, skills and attitudes expected from high-performing practitioners of the degree-specific discipline. These assessments (along with portfolios and research projects in some programs of study) are the evaluation criteria used for granting a degree or a certificate. With this approach, life and work expe-

rience count as much as coursework. Students can apply skills and knowledge gained on the job or through self-directed study toward a WGU degree.

WGU articulates competencies for each program with the assistance of recognized leaders in education and industry. The articulation of essential learning areas forms a domain structure within which specific performance expectations of program graduates are articulated on a per-domain basis. Essential domain-specific competencies identified by diverse groups of subject matter experts are validated by comparing them with standards of performance set by professional organizations for members of the targeted profession. A Program Council of respected practitioners from academe and from business and industry is then established for each degree or certificate program. Program Councils function as the "virtual faculty" for each of WGU's degree and certification programs. As faculty members, Program Council members must review and approve the articulated competency statements within each domain that is defined for a degree or certification program. Program Council members periodically review articulated competencies to ensure that they are up-to-date and appropriate. Program Council members also work with WGU's Assessment Council on the construction of program specific assessment experiences, review the results of student assessments, and, in some programs, participate in conducting field observations, oversee bench tests, and/or conduct face-to-face oral examinations of candidates for degrees.

WGU Advisor/Mentors work with students to review their areas of strength and weakness, and to recommend strategies for building competency in the domains of a student's degree or certification program that need development. Pre-assessments and self-reflection guide students to appropriate learning experiences, including courses offered by the institutions that are part of the WGU partner network.

KOMPETANSENETTET: A NATIONAL COMPETENCY-BASED PROFESSIONAL DEVELOPMENT NETWORK

Kompetansenettet[1] is an online learning management system implemented in Norway under contract with Næringslivets Hovedorganisasjon (NHO), the Confederation of Norwegian Business and Industry. Its intent is to help users improve their job performance by focusing training and education activities on building essential, job-specific knowledge, skills and attitudes rather than

[1] *Kompetansenettet* is a customized implementation of Informania, Inc.'s WebLearn® Plus learning management system.

emphasizing mastery of a body of knowledge that may or may not be applied on the job.

The genesis for implementing *Kompetansenettet* was the demand for the provision of professional development opportunities for up to 10% of a worker's time on the job. As part of the strategy for responding to this charge, businesses looked to technology-mediated training as a solution for meeting the professional development needs of workers while minimizing the impact of workers' time away from the workplace spent pursuing training opportunities. NHO indicated its interest in using *Kompetansenettet* to document *realkompetanse* – the professional knowledge, skills and attitudes developed over time but not sanctioned or acknowledged by official learning credentials or certifications.

Kompetansenettet makes active use of competency models that define the scope and focus of knowledge, skills and attitudes attributed to excellent performers in a given job category or learning area (Klemp, 1980). In the initial pilot implementation of *Kompetansenettet,* existing web-enabled courseware available from multiple vendors was reviewed, analyzed, and mapped to relevant elements of appropriate competency models. Wherever possible, competency models were validated using third-party data sources such as professional certification guidelines and "best practices" data from professional associations to enhance their validity and their generalizability.

Kompetansenettet was designed to compare an employee's job-specific knowledge, skills and attitudes with standards of performance established by excellent performers in those same job-specific knowledge, skill, and attitude arenas represented in the competency models registered in *Kompetansenettet. Kompetansenettet* users complete assessment exercises in relevant learning areas and the results diagnose a user's strengths and greatest opportunities for improving his or her job-related knowledge skills and attitudes. *Kompetansenettet* uses the results of these assessments to prescribe an individualized learning plan. The learning plan consists of modified content objects (typically topic-oriented modules contained within existing web-based courseware) that correlate with competencies expected of a high-performing employee in specific job classifications.

While *Kompetansenettet's* unique value lies in its ability to apply competency-based learning strategies and tactics to improving workplace performance, it also offers robust search and retrieval capabilities as an effective means of managing various forms of web-enabled learning content, including intact courses and modules contained within an extant course. This is a response to two real-world contingencies:

1. At the time that the system was to be implemented, there was

relatively limited Norwegian language web-enabled content available, and

2. The vast majority of available web-based instructional content is knowledge-based rather than competency-based.[2]

Kompetansenettet's search and retrieval functionality is enabled by means of metadata tags that index all data elements in the system. Content mapped to competencies registered in *Kompetansenettet* will use several categories of metadata tags, including those that specify format attributes, subject attributes, and competency attributes. Content that is not correlated to a specific competency contained in a registered model typically only display format and subject metadata tags. Whether or not content correlates directly to a registered competency model, use of the format and subject metadata tags increases the number of index terms/access points, making it easier for users to locate relevant content resources.

CASE STUDY OBSERVATIONS

The outcomes of these two competency-based learning implementations have surfaced a number of issues that underscore the challenges of implementing competency-based learning programs using web-enabled learning technologies. These include:

- *Knowledge-based learning designs vs. competency-based learning designs.* The competency-based learning designs featured in the Western Governors University and in *Kompetansenettet* attempt to establish a direct, positive correlation among:
  - — The competency standards for a degree certification or professional development programs.
  - — The assessments developed to benchmark an individual's competencies against standards of excellent performance for a targeted program of professional performance improvement.
  - — The modularized learning resources – "learning objects" – linked to assessment results that can build learning capacity in the arena identified by the assessment tests. Learners have empirical evidence to help discern the specific areas within a given competency model where performance improvement is warranted.

[2] In a knowledge-based learning model, content is organized around topic or subject attributes rather than around discrete performances expected of excellent performers as described in a competency model.

The vast majority of content that is currently available from universities, publishers, and commercial course providers is still based on the "knowledge model" as constructed by subject matter experts. In a "knowledge model," content is organized around topic or subject attributes rather than around discrete performances expected of excellent performers. While a shift from the "Subject Matter Expert" approach to the "Expert Performer" approach will ultimately result in greater availability of modular, reusable learning objects, content providers who are accustomed to producing fully integrated courses may very well question the value of changing the way that they organize learning content. While Jennings and others have already predicted the "death of the online course" (Jennings, 1999), content providers have not yet broadly embraced the creation of digital content objects as courseware building blocks. Until such objects are more readily available, the ability to construct fully personalized competency-based learning plans may be compromised by the relative lack of availability of competency-specific content object resources.

- *Online courses vs. learning objects.* Currently there is a strong emerging trend that calls for using learning objects as the building blocks for constructing learning interventions that meet specific interests and needs of individuals. Nevertheless, the most typical way in which individuals complete online learning experiences is by means of online courses. There appear to be two reasons to explain this phenomenon. The first is that the idea of constructing a personalized learning program by selecting and assembling the array of learning objects that best correlate with learning interests, performance gaps, learning style and presentation preferences is still relatively new. Courses represent the most familiar way to offer learning content to students, whether a classroom-based, instructor-led course or a web-based, instructor-led course from a virtual institution. This familiarity goes a long way in establishing the trust between the learner and the e-learning solutions provider that is necessary for building brand loyalty. Nevertheless, the notion of comfort with the familiar in an unfamiliar virtual space will increasingly find itself balanced against that of improved productivity and competitiveness enabled by leveraging organizational knowledge and personalizing e-learning programs. Second, there is the issue of learning object interoperability. Most commercially available online providers purport that their software meets AICC, IMS or IEEE interoperability standards. However, these courses come bundled with proprietary CGI, user-tracking and course player code that compromises interoperability. Even though individual units or lessons of an online course can be indexed using metadata

tags to allow launching and displaying only a part of a course, users cannot typically enter and exit an extant course without compromising navigation and user-tracking functions. Until such time when reusable learning objects are readily available within organizations, from commercial content publishers or from content aggregators, online learning designs will continue to emphasize presenting content in the ready-to-use, familiar form of the course.

- *Competency articulation for knowledge-oriented programs.* The articulation of competency standards for the excellent performer works well in vocational education, practice-based performance improvement and professional educational and development programs. How well can a competency-based learning model be used to define the expectations for a general educational program or a professional development program based entirely upon "soft skills" (e.g. leadership) that are hard to quantify?

- *Standards for Learning Architecture Learning Objects.* There currently is no single standard used to ensure interoperability of learning/information/content/knowledge objects. Unlike LAN or CD-ROM development environments where closed proprietary protocols tended to guide the design, development and deployment of digital learning resources, developers producing web-enabled content must ensure that open, non-proprietary standards form the foundation of the learning resources development process. The establishment of standards for learning architecture and learning objects is, therefore, based upon the goal of defining interoperability protocols so that all learning objects can be used on all varieties of learning management and content retrieval systems. Learning object-oriented standards tend to be either learning-focused or technology-focused. Learning-focused standards address issues related to content, metadata and the establishment of a learning management system data model, while technology standards typically address issues associated with the interoperability of HTML, HTTP, XML, Java and JavaScript (Hodgins, 1999). During the past year, several learning technology initiatives have emerged as major stakeholders in developing open specifications. Vendors, academics, government agencies and industry consortia are collaborating to ensure that web-enabled learning technology products can interoperate with one another, although uncoupling learning objects from the context of a "parent" course continue to present course player problems. Drivers for maintaining the need for working together to establish interoperability standards include uncertainty (e.g. what standard is likely to emerge as the "lingua franca" of online learning object deployment?), and the inability of any one initiative to solve the problem alone. There

is a shared expectation that the various initiatives involved in defining learning technology standards will negotiate a convergent solution rather than adhering to a single organization's "proprietary" approach. According to Hodgins, the various learning technology initiatives will eventually submit mature specifications to the IEEE LTSC for standardization, since the IEEE is an accredited standards body (Hodgins, 1999).

- *Dealing with "Coopetition" (a term that combines the terms "cooperation" and "competition").* This refers to the uneasy alliance of organizational partners who have decided to collaborate on a specific venture, even though they may be direct competitors in different settings. An example of coopetition can be seen in the challenges faced by courseware vendors accustomed to developing their products for sale using the standard knowledge-based approach to course design. What happens if a course-based content provider chooses NOT to create modularized content that can be deployed in a CBL application? Will their competitors who do accommodate modularization be better prepared to repurpose similar content for multiple uses? Considering the WGU example, will traditional universities be willing to configure their current courses into modular objects, for use by another institution of higher education? Even though WGU and its partner institutions purport not to compete for the same kinds of students, traditional institutions are keenly interested in leveraging their own institutional capital in establishing new student market share.

- *Valid, Reliable and Predictive Assessments:* How can an individual (or an organization) be assured that the assessments used to predict an individual's ability to perform a job effectively are statistically valid, reliable and predictive? What variety of assessment experiences (e.g. objective tests vs. reflective tests, multiple choice vs. "point and click" graphical response items) is the best measure of the learning gained? If the selection of learning resources is to be based upon profile criteria selected by and for an individual learner, then the validity, reliability and predictability of the instruments that quantify profile attributes must be empirically supported. Knowledge-based and competency-based assessment instruments may range from objective multiple choice items to online case-based simulation, skill demonstrations, or the preparation of a professional portfolio, depending upon the learning to be assessed. Whatever the format of the assessment exercises, the importance of employing methodological rigor when designing instruments to prescribe personalized learning resources that are valid, reliable and predictive cannot be overstated. This is especially critical when constructing resources used for assessing integrated, situated prob-

lem-based abilities in (simulated) applied settings. At a minimum, poorly-designed assessments may only scratch the surface of the essential knowledge, skills, and abilities needed to function as a highly competent practitioner. In practice, poorly-designed assessments can obscure the extant competencies held by the individual being assessed; any learning prescriptions based upon inaccurate diagnoses may themselves be inaccurate, invalidating an individual's personalized learning plan.

SUMMARY

These two case studies describing the implementation of technology-mediated competency-based learning initiatives illustrate some of the issues encountered when implementing the vision of competency-based learning designs in practice. Competency-based learning is a particularly useful strategy when used with learning management systems where content is stored as reusable learning objects. The potential benefits of competency-based e-learning solutions suggest that the issues facing developers of this approach are likely to be resolved in the near future. Technical standards for reusable learning objects will be adopted, motivating developers to produce more content in reusable object form, and competency models will provide the structures for adaptive, personalized learning systems available when and where learners need them.

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Learning without Limits, vol. 3

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