



The Job is the Learning Environment: Performance-Centered Learning and the Use of Question-based Reasoning to Support Knowledge Worker Performance

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Abstract

Changes in the work environment have placed a premium on just-in-time education and training. While performance support technologies have significantly improved discrete task support, there is still a void in addressing the non-repeatable, context specific tasks usually performed by knowledge workers. Work on Constructivist Learning Environments (CLEs) has provided insights to building learning environments that more closely mimic the work place. Unfortunately, these are usually developed for access independent of the job. To effectively aid knowledge workers in the process of performing, the author advocates viewing the workplace as the learning environment, in which there is a direct merging of the organization's knowledge and training assets. This approach, termed Performance-Centered Learning, can be implemented through a methodology called question-based reasoning. Development and implementation guidance will be provided along with how QBR can be integrated with the ADL initiative.

Introduction

This paper will discuss the idea that the workplace should be seen as the learning environment. Instead of developing training resources for independent learning (termed a learn-then-do methodology), we should be designing our learning assets specifically for use on-the-job when the knowledge worker is engaged in solving a problem or performing a task. To do this effectively, learning assets need to be intimately merged with knowledge assets developed by practitioners and tied collaboration among peers and experts. In laying this out, this paper will review current changes in the work environment, and how this leads to the idea that we should be marshalling all our information resources to support knowledge workers who are learning while engaged in the process of doing. A Performance-Centered Learning approach will be advocated, and will then be compared and contrasted with existing methodologies employed, including Constructivist Learning Environments, Performance Support Systems, and Just-in-Time Learning approaches. Implementation guidance will be provided by discussing linkages of content to knowledge domains, and how a Question-based Reasoning methodology can be applied to build Performance-Centered Learning structures. The article finishes with a discussion of possible linkages with the Advanced Distributed Learning Initiative.

Changes in the Work Environment

Over time, technological innovations have significantly altered the way work is performed. Work processes can now stretch across multiple locations, requiring many applications to perform the required tasks. Stresses on productivity have forced changes in lines of communication and management oversight strategies. Organizational structures have become dis-intermediated and personal networks have broken down. All this has led to an increased stress on the need for improved worker performance.

Many tasks performed by workers are complex, and non-repeatable, and involve analysis, synthesis and production of knowledge. To perform these tasks, “knowledge workers” are continually learning and adapting to the circumstances presented. They must rely on their own experience and understanding of the task to correctly associate it with the context. Often the task performance involves finding answers to complex questions, and identifying and solving seemingly unique problems.

Performance in this work environment places significant emphasis on continuously learning and growing individual expertise to meet these continually changing challenges. Knowledge workers must often rely on their personal contacts and favorite resources to augment their continually growing experience base. While some are able to continue to learn and adapt, many struggle with complex and changing environments.

The Job is Where Learning Occurs

Studies have shown that as much as 85% of all learning occurs on-the-job (Raybould, 2000). Knowledge workers seem to learn best when in the process of performing. Through the process of encountering problems and engaging in inquiry, they increase their overall understanding and skills that relate to their job performance. Donald Schon calls this process “reflection-in-action.” Schon states:

“In his day-to-day practice he makes innumerable judgments of quality for which he cannot state adequate criteria, and he displays skills for which he cannot state rules and procedures. Even when he makes conscious use of research-based theories and techniques, he is dependent on tacit recognitions, judgments, and skill full performances...It is this entire process of reflection-in-action which is central to the “art” by which practitioners sometimes deal well with situations of uncertainty, instability, uniqueness, and value conflict” (Schon, 1983).

It is this process of learning-while-doing that knowledge workers engage in when performing. The knowledge worker is not engaging in learning to improve their knowledge and skill base, they are doing so to solve job specific problems or to accomplish job-specific tasks. This learning-while-doing approach is also supported by research in Action Learning. Revans, the founder of Action Learning recently stated:

“One of the most important developments in management learning and development over the past decades as been the growing realization that learning occurs best when it is directly related to real work, to “doing,” or to action” (Revans, 1998).

Learning is not the primary goal, but is often necessary in the process of performing. Yet, over time, knowledge workers that are learning-while-doing will advance in their skills and job knowledge. This leads knowledge workers to an inextricable linkage between knowing and doing in the context of their work environment (Choi & Hannafin, 1995). Their ability to

perform tasks and solve problems will grow, until eventually they are considered subject matter experts (SMEs) within their knowledge domain.

Support for Knowledge Workers Engaged in Learning-While-Doing

Currently there is significant discussion over how to best support on-the-job knowledge worker performance. It is clear that knowledge workers need access to both people and information resources while performing, but the method for providing this assistance varies. While performing, the knowledge worker is engaging in inquiry to solve problems and to create knowledge assets. Because the knowledge worker is dealing with context-specific issues and problems, access to information resources needs to be designed in a way that allows the knowledge worker to quickly locate and apply pertinent information.

In examining the need to support knowledge workers that are engaged in learning-while-doing, research focused on adult learning may provide the requirements for support. Within the educational community, there is significant discussion over how to support the continually changing role of the adult learner (Curry, 2000; Merriam & Cafferella, 1999). In understanding the needs of adult learners, Andragogy, the art and science of helping adults learn, has come up with six assumptions about the adult learner:

1. Adults need to know why they need to learn something before learning it,
2. As a person matures, his or her self-concept moves from that of a dependent personality toward one of a self-directing human being,
3. An adult accumulates a growing reservoir of experience, which is a rich resource for learning,
4. The readiness of an adult to learn is closely related to the developmental tasks of his or her social role,
5. There is a change in time perspective as people mature, from future application of knowledge to immediacy of application. Thus, an adult is more problem centered than subject centered in learning, and
6. Adults are motivated to learn by internal factors rather than external ones. (Merriam & Cafferella, 1999; Holton, et al, 2001).

Barkley and Bianco elaborate on these principles by applying adult learning principles to online learning (2001). Learner-centered navigation and design is critical for successful adult learning. This navigation approach must be combined with training assets devoted to on the job performance. Adult learners with familiarity to a subject area are often interested in addressing very specific questions, problems, tasks or knowledge deficiencies. When they have their answer, the tendency is to return to the real world task or issue at hand. They are often less interested in assessing their knowledge and skill gains independent from the task or issue they are addressing.

The learning-while-doing approach is also firmly grounded in principles of constructivism. Constructivism posits that meaning is constructed by the individual's experiences and is dependent on the individual's previous and current knowledge structures, and that people are most readily able to learn when working on real world tasks and problems (Merriam and

Cafferella, 1999). Constructivism lends a number of potential design considerations to support a learning-while-doing methodology, including:

- Providing experience with the knowledge construction process,
- Providing experience in and appreciation for multiple perspectives,
- Embedding learning in realistic and relevant contexts,
- Experiencing learning in "rich" environments, and
- Encouraging learning in social experience (Edwards and Havriluk. 1997).

Related Approaches to a Learning-While-Doing Methodology

A number of approaches have linkages with a learning-while-doing methodology. Constructivist Learning Environments (CLEs), Just-in-time learning and Performance Support Systems all have aspects of a learning-while-doing methodology. Each approach has provided real benefits towards the performer. This paper will briefly examine each in relation to supporting a learning-while-doing methodology.

Constructivist Learning Environments

The Goal of Constructivist Learning Environments (CLEs) is to aid the learner in the knowledge construction process. CLEs excel at providing opportunities for skills development. Multi-perspective task oriented guidance and collaboration with peers provides all the information necessary to aid the learner in placing the task in context. Research in situated learning environments only further confirms that meaning is constructed through interpretation of experience and social negotiation in context, and that to assist the learning process, learning should be placed in an authentic context (Hemmes et al, 1998).

Jonassen, in discussing CLE development, provides three essential design principles: context, collaboration and construction (Jonassen, 1994). Context refers to the notion that learning must be situated in a real world meaningful task; collaboration relates to the idea that learners are constantly interacting in a social world, and construct meaning through participation and collaboration with others; construction refers to the idea that the CLE must facilitate learners in the process of creating or constructing meaning in their own heads, and not simply providing it as a knowledge transfer. Willis builds on Jonassen's three principles of context, collaboration and construction by adding three flexible design guidelines: recursion, reflection and participatory design (Willis, 2000). Recursion refers to the need to build non-linear design structures; reflection refers to support for Schon's reflection-in-action in a learning context (Schon 1987), and participation refers to the need to engage the learners in a participatory design process to develop a meaningful CLE.

Yet, while CLEs engage in a learning-while-doing learning process, they are most often designed for access independent of the real world job environment. They are still problematic for on-the-job application for a number of reasons: CLEs take a long time to build; CLEs are hard to maintain, and while providing firm foundations for skills development, CLEs are designed for access and use independent of actual job performance. Knowledge workers engaged in performing will still need to translate the CLE's utility to their job-specific context.

There are numerous instances when learning is required prior to real job performance. In these instances, CLEs provide an excellent means of meeting the needs of the adult learner. However, it is still critical to provide the proper scaffolds to knowledge workers engaged in performing. This is when knowledge inconsistencies and misunderstandings lead to performance problems.

JIT Learning

Just-in-time (JIT) learning options have sprung out in many different forms. Unfortunately, JIT learning options usually operate under the assumption that knowledge is a stockpile of *discrete* ideas, concepts or tools that can be delivered as needed. The systemic relationships among concepts and skills are minimized in this approach (Riel, 2000). This requires that the knowledge worker engage in an independent search and discovery process to determine whether the JIT learning assets relate to their needs. JIT learning options often stem from an attempt to reuse content that had been structured for an independent, learn-then-do approach. While very useful, the lack of systemic relationships among the content in most JIT Learning solutions take away from the learner-centered approach necessary to support a learning-while-doing approach.

Performance Support Systems

Performance support systems have led to dramatic performance improvements in many different settings. Performance support systems embed the process and business knowledge required to accomplish discrete tasks, thus, requiring the performer to need only recognition of the actions instead of complete recall. Gary Dickelman, a leading expert in performance support and Performance Centered Design has speculated in lectures that at least 50% of all tasks in business organizations fall into a category that can be addressed through performance support. But what about the other 50%; the non-discrete, non-repeatable tasks that often plague knowledge worker performance? While these tasks are critical, they are not repeatable and do not lend themselves to traditional performance support tools. The performance of non-repeatable tasks are driven by the context of the situation, including dollar and time constraints, political realities, and the skills and understanding of the performer. Additionally, a large percentage of these tasks have a clear time element - they must be accomplished in real time. Performance support tools, while providing significant benefits in terms of performance improvements are not geared towards addressing these problems.

Use of Independent Learning Approaches to Support Learning-While-Doing

Most approaches to education and training currently offered are structured and delivered for independent learning. This training is often sequential in nature, and is designed for self-paced learning. Generally, self-paced instruction provides an organized body of information and exercises that are trainer-centered (Wilson, 1999). The goal is for an educator to take the material in a knowledge domain and structure it in an educationally sound format that, if taken in totality, will provide the learner with either additional knowledge or improvement in skills.

In discussing systematic models for instructional design, Wilson states that, “By its nature, instruction is removed from the work context...the two spheres are kept separate for convenience and efficiency” (Wilson, 1999). Training that is independent of the job supports a “learn-then-do” approach to education. It is not designed to be accessed while in the process of performing. When attempting on-the-job access of learn-then-do training material, the knowledge worker must negotiate the trainer-centered navigation structure to attempt to apply it to their unique

needs. Often a translation is required – the knowledge worker must extrapolate the trainer-centered material in order to connect it to their particular context and problem set.

Studies have shown that training that is conducted independent of the job loses its effectiveness in a relatively short period of time (Mager and Pipe, 1997; Hemmes et al, 1998; Clark and Estes, 2000). In some studies, it has been shown that training products and strategies actually reduce the ability for people to use their work related knowledge (Druckman and Bjork, 1994; Druckman et al, 1997). Unless the training is directly related to a person’s job skills, it does not lead to significant differences in performance or improvement in knowledge. When combining this with the idea that 85% of all learning occurs on the job, the potential for independent learning for improving on-the-job performance is not very high. If done well, when structuring content for learning independent of the job, the overall potential performance gain for the training may only be around 15% (Raybould, 2000).

To get the most return on training investments, the learning resources should be devoted towards providing scaffolds that are integrated into the work environment. Even if the training investments provided in a learn-while-doing approach are poorly developed, the potential performance gain is far greater than excellent learn-then-do training investments. The learn-then-do approach, while useful for novice learners, is less effective for adult learners who already have some familiarity with the subject area.

A learning-while-doing approach involves significant differences from learn-then-do training. A learn-then-do approach is useful in novice training and in instances where real world tasks are too difficult to learn on-the-job. Yet, too often, a learn-then-do approach is employed in instances where a learning-while-doing approach would be better suited to the learning need. An understanding of the differences in approaches is required to determine when to employ one over the other. The chart below describes these differences in detail:

Elements	Learn-Then-Do	Learning-While-Doing
Navigation, flow of content	Self paced or Instructor mediated lecture. Navigation follows sequential flow of the content.	Learner-driven. User-centered Navigation allows the knowledge worker to hyperlink through the knowledge domain
Degree of content usage	All material is covered upon completion	Material covered is based on inquiry
Content Association	Set Lessons w/associated tests	Question-based reasoning methodology
Temporal association	Scheduled Event, time specific	JIT, non-time specific
Job aids	Seen as outside resources	Intimately linked with learning assets
Assessment strategy	Assessment is in the testing process	Assessment is tied to on-the-job performance
Collaboration	Optional, contact w/single expert	Required, contact with numerous peers and experts

Table 1: Differences between a learn-then-do approach and a learning-while-doing approach

The Job is the Learning Environment: Performance Centered Learning

If we accept the notion that the job is the learning environment, then the answer as to how to support performance is clear – our learning assets, knowledge assets and performance support tools must be designed and integrated to support knowledge workers engaged in the process of performing tasks and solving problems. At that moment in time when the knowledge worker is in need of finding information, generating new skills, accessing job aids, or engaging in conversation, all relevant resources should be marshaled to support them. This is the time they will be most receptive to expanding their experiences and leveraging their backgrounds (Revans, 1983).

This approach, which I term Performance-Centered Learning (PCL), requires that, while performing in the real work environment, the knowledge worker has access to context specific learning assets, job related templates, tools, access to experts, and experiential data from peers (case studies, lessons learned). These items are not stored in a library or pick list, independent from one another, but are evaluated by SMEs and then associated within the broader context of their place in the overall knowledge domain. These resources must to be both instantly available and directly related to the problems and tasks the knowledge worker is engaged in addressing. This is a systemic, holistic approach to optimizing support for performance on the job. PCL support elements include:

- Fundamental learning information in non-sequential format,
- Explanatory content,
- Process information,
- Task guidance information,
- Relevant performance support tools,
- Templates,
- Examples,
- Case studies, lessons learned and best practices,
- Access to experts, and
- Access to peers.

These PCL assets, while revealed in a list, are not provided in a non-integrated, ill-structured fashion, but are organized specifically around the needs of the performers. PCL assets need to be tied together where relevant around the problems and tasks faced by the performers. This structure must support both the discrete, repeatable tasks and the more difficult non-discrete, non-repeatable tasks. All learning assets, knowledge assets and performance support tools should be designed and integrated into a learner-centered format, in which the knowledge worker is completely in charge of the path taken through the material. In the process of performing, the knowledge worker must be able to distinguish the assets that are relevant to their needs at that moment in time. This means that there is no direct sequence through the content. Instead, the content must be structured to allow the knowledge worker to access just the portions that apply to their particular circumstance. The starting and ending points are completely determined by the knowledge worker. Each time the PCL structure is accessed by the knowledge worker, the path through the material may be radically different.

Implementation: Association of PCL Structures to Knowledge Domains

The holy grail of knowledge management content delivery concerns the issue of how we deliver content in a way that directly relates to the context of the knowledge worker (Cowley-Durst, 1999). We take as a given that the knowledge worker supplies the context, so how can we structure the content such that the knowledge worker can easily map their context onto the information resources provided? At first glance, this appears to be an unanswerable dilemma: we can never get inside the knowledge worker's head, so how can we know the scope of the problem the knowledge worker is dealing with or the chain of events that the knowledge worker is on, and more importantly, what he or she would be interested in next? If we can't come up with an answer for this, how then can we legitimately say we are employing learner-centered navigation concepts, as this implies posing information towards how learners interpret the world?

In short, the answer lies in associating the PCL assets to knowledge domains. Knowledge workers, in the process of performing, are accessing a set of related concepts, experiences and skills associated with a particular domain of expertise. They are continually associating these concepts, experiences and skills with their current contextual environment. Usually, this domain of expertise, or knowledge domain is a shared entity. Many others are working with very similar sets of related concepts, have undergone similar experiences and are developing similar skill sets. Through providing a means of traversing this set of related concepts, experiences and skills information, we can provide the knowledge worker the ability to make the association of this information to his/her particular context.

Lets examine this in more detail: for our purposes, a knowledge domain can be thought of as a detailed semantic map that contains sets of interrelated concepts, a history of events, agreed upon process information, important arguments and discussions, identified skill sets and job roles, and various knowledge artifacts, including templates, examples, case studies and success stories and failures. There are SMEs operating within a knowledge domain that understand and associate this body of information to specific tasks and problems within specific contexts.

Knowledge domain information can be broken up into information "chunks" or "nodes." Information nodes can contain things like descriptive and referential information, process charts, policy documents, implementation guidance, historical information, captured lessons learned, agreed upon best practices, etc. These information nodes should be seen as logical chunks of information that are themselves understandable apart from other pieces of information. In addition, each knowledge domain will have certain attributes or "organizing concepts" which most knowledge domain SMEs draw upon to associate the knowledge domain information to their particular context.

The SMEs do not view these chunks of information solely as independent entities; they understand them in terms of their relationship to other chunks of information. These knowledge domain nodes are organized into multiple, intersecting relationships of semantic meaning. If we accept the notion that a knowledge domain comprises a number of intersecting concepts and information nodes, then the knowledge worker, in the process of performing a task, is operating off of a mental model of the conceptual relationship structures within a knowledge domain. A

group of knowledge workers operating in the same knowledge area will develop socially constructed and shared mental models of the knowledge domain (Jonassen and Henning, 1999).

By employing techniques developed in expert systems and performance support systems, we can extract this set of concepts and relations from knowledge domain SMEs. Once this is done, we can utilize hyperlinks in a web-based environment to allow the knowledge workers to essentially traverse content within this structured knowledge domain. This process involves:

- Identifying a knowledge domain,
- Identifying the problems, tasks and questions people associate with the knowledge domain,
- Identifying the organizing concepts within a knowledge domain,
- Gathering content from knowledge domain SMEs into back-end data structures,
- Storyboarding the content from the data structures into logical chunks or nodes of information,
- Associating the nodes of information (in the form of storyboards) within the knowledge domain around the problems, tasks and organizing concepts, and
- Coding this structure into an online, web based form that allows additional contributions and changes by knowledge domain participants.

The goal with PCL is not to automate the information resources in a knowledge domain – its to improve the performance of the knowledge workers. A PCL design approach is significantly different than what is normally advocated in knowledge management implementation efforts. Often knowledge management is concerned with collecting knowledge domain artifacts so that they can be associated with an agreed upon knowledge domain taxonomy (Lesser et al, 2000; Cowley-Durst, 1999). While the taxonomy lays out the set of organizing concepts (knowledge domain attributes), and can be used to trace the relationship between the information nodes and the organizing concepts, it does not trace the relationship between the information nodes themselves. The nature of the relationships between the information nodes within a knowledge domain are as important as their relationships to the organizing concepts.

The content organization approach for PCL structures should be clear – the content should be organized around the problems, tasks and organizing concepts used by participants in that knowledge domain. In short, the content should be organized in the way that the knowledge workers operating in a knowledge domain social construct or see the world. A Performance Centered Design (PCD) approach should be employed for building PCL content structures. It should include upfront needs analysis that employs tasks analysis and heavy user involvement to ensure the content meets user expectations. In-depth interface usability studies should also be relied upon.

Use of Question-based Reasoning to Associate Content

Question-based Reasoning (QBR) is a methodology for associating and linking content within a knowledge domain. Foundations for this approach come from a number of sources including Roger Shank's Institute for Learning Sciences, which developed similar structures for their ASK systems (Shank and Cleary, 1995) and from research into inquiry-based learning (Looi, 1998).

QBR allows us to work through a process to code via hyperlinks the content set in web-space. This methodology is very powerful both for enabling performance-centered learning modules for job performance support and for context specific help files within applications. Other practical applications of approaches similar to QBR include the use of a question and answer methodology for capturing, organizing and reusing knowledge expertise (Budzik, 1999), and the use of inquiry to connect theory, research and practice to support performance (Brethower, 2000).

The underlying premise of QBR is that SMEs have, in their heads, a structured set of relations among content in a knowledge domain. This set of relationships can be extracted by having the SMEs engage in a structured process of comparing the information nodes to one another see how they're related. These "pair-wise" comparison techniques allow a knowledge engineer to work with SMEs to the extract the set of relationships among the nodes information within a knowledge domain. In comparing two pieces of information, there are a number of ways that two different information nodes can be related:

- Information node A provides **overall context** to information node B (Parent-child hierarchy, organizing concept, overall process perspective),
- Information node A provides a **details** to information node B (parent-child hierarchy),
- Information node A provides a **comparison** to information node B,
- Information node A provides a **lesson learned** to information node B,
- Information node A provides a **warning or potential pitfall** to information node B,
- Information node A provides a **implementation guidance** to information node B,
- Information node A **leads** to information node B (sequence, process or task step),
- Information node A is a **function** of information node B (system decomposition hierarchy), and
- Information node A is a **tool** for information node B.

It is the intersections and relationships between the information nodes that provides context. The purpose of each information node, if viewed in isolation, must be extrapolated by the SME. If information nodes are contained and associated within a larger knowledge domain relationship structure, the knowledge worker can more easily associate their particular context to the relevant information nodes by tracing or navigating through the relationship structure. Figure 1 shows a notional diagram of how each information node is linked to other information nodes within the knowledge domain.

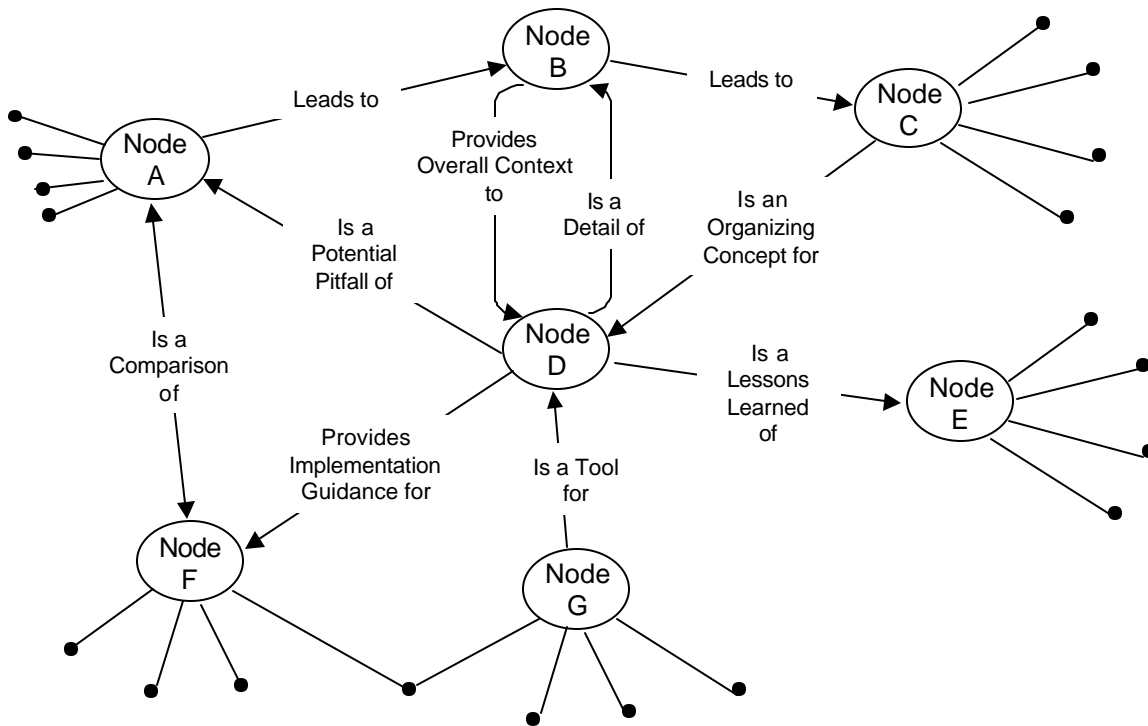


Figure 1. Knowledge Domain Information Node Relationships

QBR allows the development of a sophisticated learner-centered navigation structure. The goal is that when the knowledge worker is accessing a single information node, all the additional nodes the knowledge worker might most often care about will be available as a hyperlink. The hyperlinks will be posed in the form of questions, and the answers to the questions will be the titles and associated content found on the hyperlinked page. There are potential pitfalls associated with this approach - problems uncovered in traditional open-ended hypermedia information systems that have the potential of reducing their educational effectiveness include disorientation and the need for linear navigation (Hill, 1999). Because the QBR navigation structure is intimately linked to concepts and relationships in a knowledge domain, it is hoped that this additional structure will aid knowledge workers unfamiliar with non-linear navigation to adapt. Other mitigation strategies include encapsulation of information into larger “chunks” so that the details of the link structure are segregated into fewer, more manageable pieces.

In looking at QBR’s place in a broader context, we can draw on Wilson’s evolution of learning systems framework (Wilson, 1999). Wilson has posited an evolution of learning systems, in which we have gone from Instructional Design, to Performance Support to Network Systems. Instructional Design has prepackaged solutions in which instruction is removed from the work context; Performance Support has prepackaged solutions in which learning has moved back into the work context, and networked systems involve non-linear, changing structures in which the practitioners serve as co-designers. Networked solutions are intimately tied with the work environment. They can involve many elements, including static pages, search engines, KM systems, threaded discussion and conferencing, multimedia presentations, and embedded performance support tools. QBR can also be seen as an attempt to develop a Network System navigation scheme to support learning and performance.

Example: The Risk Management Focus Area as a Developing PCL Approach

The Department of the Navy OASN (RD&A) Acquisition Reform Office and the Department of Defense Acquisition University (DAU) are in the process of developing a Community of Practice (CoP) site (Lesser et al, 2000) to support Department of Defense Acquisition Program Managers. Within the Program Manager (PM) CoP, key functional areas of expertise were chosen to enable community building and performance support. The Risk Management Focus Area, one of five key focus areas selected, is employing a performance-centered learning approach towards building and supporting a CoP around the performance of Risk Management tasks and activities.

When released (September, 2001) the Risk Management Focus Area will provide just-in-time learning, collaboration and performance support tools to improve overall on-the-job risk management performance. The intent is for acquisition workforce personnel to use the site when in the process of performing risk management tasks or addressing risk management problems. QBR will enable the structuring of this content for online interaction in just-in-time support or performance-centered fashion.

The approach taken in the Risk Management Focus Area is an explicit merging of learning assets developed by instructional designers and knowledge assets developed and submitted by risk management practitioners. In associating content to the risk management knowledge domain, the Risk Management Focus Area team engaged in community building to gather a group of risk management experts (both program managers and risk managers) to identify problems and tasks facing program managers. Additional work was accomplished to uncover the common questions usually asked by novices and practitioners engaged in implementing risk management.

The content will include guidance documents, examples, templates, and lessons learned information. In some cases, the knowledge assets are being transformed into online performance support tools that will aid in task performance. Online discussions and project based collaboration among risk focus area members are being cultivated and encouraged. This, along with risk fundamental learning information, process information, and access to peers and experts will provide a solid foundation of content from which to support program office professionals.

A performance centered design approach is being employed for site design. To validate the design, both usability testing and performance evaluations will be employed on the both interface and content. By using both experts and novices in the design process, the Risk Management Focus Area community site will be tested and refined until it is both usable and improves acquisition worker risk management performance.

Implications to the Advanced Distributed Learning Initiative

A performance-centered learning approach can significantly leverage outputs from the Advanced Distributed Learning (ADL) initiative (<http://www.adlnet.org>). The ADL Initiative advocates the chunking of content in courseware development efforts. This allows the chunked content to be re-used and re-purposed. If an ADL approach to courseware development is employed, organizations can begin to develop and maintain the “chunks” of content for later inclusion into performance-centered access. Content developed for online courseware can be associated with

organizational knowledge assets and job aids. This allows all pertinent organizational expertise to be marshaled to support on-the-job knowledge worker performance.

A QBR approach, when applied to the ADL initiative, would still provide an excellent means to re-purpose chunked content into a PCL approach. Orrill, in investigating the use of learning objects for supporting inquiry-based learning concludes that inquiry based learning objects allow the learner to form their “own bodies of understanding” of the content (Orrill, 2000). The QBR structure would allow multiple viewpoints of the information chunks to be created and maintained for different users and different purposes. This provides the leading edge of applying constructivist education principles to on-the-job performance.

As advances in the learning object repository portion of ADL matures, it is likely that we will be able to create sophisticated relationships among content nodes in multiple repositories. Instead of having to extract assignable units of instruction of pre-developed courses, QBR structures could be created by directly accessing the various repositories, independent of ownership or location. This approach would require an additional information management role – there are already information owners who maintain the information chunks – now there will be information owners who maintain the QBR relationship structures among the content chunks in the various locations.

Conclusion

Knowledge workers, when in the act of performing, are often posed with problematic situations and tasks. These problematic situations and tasks often require the knowledge worker to learn-while-doing in order to solve the problems or successfully complete the tasks. To support this, the knowledge worker, while engaged in the process of performing, must have access to integrated learning assets, knowledge assets, performance-support tools, and collaboration with peers and experts. A performance-centered learning methodology argues that to do this well, these should be tightly integrated into a learner-centered navigation scheme that allows the knowledge worker to traverse the associated knowledge domain. Question-based Reasoning provides one vehicle for accomplishing this.

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