

Beyond the Learning Process and Toward the Knowledge Creation Process: Linking Learning and Knowledge in the Supportive Learning Culture

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How does effective learning for employees occur within an organization? And how can organizations become more adaptive, responsive, and intelligent as a result of learning? These questions are frequently the subject of research in human resource development and performance technology. For effective learning, instructional and program design factors enhancing work transfer have been the main research focus (Lim, 2000). Apart from this direction, learning has also been studied at the organizational level by researchers of organizational learning (Argyris & Schön, 1996; Marsick & Watkins, 1999; Senge, 1990). These researchers acknowledge that organizational learning originates from employees' active and collaborative learning. In this line of research, factors other than learning, such as culture, leadership, system alignments, empowerment, teamwork, and collaboration, have been established as primary factors facilitating learning (Yang, Watkins, & Marsick, 2004). Despite common practices of applying theories of individual learning to employee development (Noe, 2004) and recognizing learning theories as the main pillar of organizational and human resource development (Swanson & Holton, 2001), few attempts have been made to synthesize views of individual learning with organizational learning.

This integrative literature review synthesizes the concepts and process of organizational knowledge creation with theories of individual learning. The knowledge conversion concept (Nonaka & Takeuchi, 1995; Nonaka, Toyama, & Byosière, 2001) is used as the basis of the organizational knowledge creation process, while major learning theories relevant to working adult learners are newly synthesized into four types of individual learning processes: adaptive, generative, transformative, and reflective. The results suggest an integrative conceptual flow map of individual and organizational learning facilitated by culture and management system enablers. Implications for using this conceptual framework for practicing performance technology solutions are also discussed.

Problem Statement and Research Significance

The scope of learning and performance technology professionals' work over the past decades has continuously expanded from the earlier focus on

improving individual learning toward enhancing learning and performance at systemwide levels, such as work groups, organizations, communities, and even nations (McLean, 2006; Swanson, 1995, 2007). While the same pattern is expected to continue, promoting sound human learning leading to actionable applications in a system remains the core of the discipline (Holton & Baldwin, 2003). Studies reporting positive impacts of an organization's learning capacity on financial performance strongly justify organizations' investment in learning (Ellinger, Ellinger, Yang, & Howton, 2002; Kontoghiorghes, Awbrey, & Feurig, 2005). However, efforts to keep up with advancements in learning theories and synthesizing them into organizational learning have been rare.

The primary objective of this research was to build a theoretically integrated framework of learning-based knowledge creation practices in organizational settings. To do that, this study has reviewed relevant research streams in areas of individual learning, knowledge conversion theory (which specifies the organizational knowledge creation process), and drivers of organizational learning and knowledge creation. Based on the research method of integrative literature review (Torraco, 2005), we propose a conceptually integrated flow map of knowledge creation and learning facilitated by a supportive learning culture and system enablers. Such a framework should help better align learning theories with organizational learning.

Conceptual Framework and Research Questions

Each researcher's specialization (instructional technology, organizational learning, and training transfer) with a common interest in learning theories and a desire to base employee development practices on research-supported knowledge drove this study. In integrating individual learning with organizational learning, we used the seminal work of the knowledge creation process (Nonaka, 1994; Nonaka & Takeuchi, 1995) as the foundation. In this framework, four types of actions are assumed to operate in sequence, resulting in a spiral growth of organizational knowledge: socialization (sharing tacit knowledge), externalization (forming justifiable explicit knowledge from tacit knowledge), combination (mixing and solidifying explicit knowledge), and internalization (reflecting explicit knowledge to enhance tacit knowledge). Such a framework could also be conceptualized as a process or booster of organizational learning, with each action representing a construct for anchoring and applying concepts and principles of individual learning theories—for example, applying situated learning (Lave & Wenger, 1991) for socialization and combination and interactional views of cognitive development (Bruner, 1997; Vygotsky, 1978) for internalization.

The literature of the organizational knowledge creation process, organizational learning, and individual learning has also identified major factors, drivers, barriers, conditions, and enablers for knowledge creation and learning to occur. For instance, Nonaka and Takeuchi (1995) found that

members' continuous learning, interactive collaborations, and reflective dialogue through the teams or functional units of the organization were critical facilitators. Similarly, Watkins and Marsick (1993) reported enablers, such as established learning processes, supportive learning culture, team learning, and collaborative communications as characteristics of learning organizations where learning is embedded in the culture and work routines. These social-constructivism-oriented views of organizational knowledge creation have generated management support for aligning organizational strategies and incentives with work and learning (Tsoukas & Mylonopoulos, 2004; von Krogh, Nonaka, & Aben, 2001). However, we find that advancements in concepts and principles of learning theories, notably in the field of education and instructional technology, such as authentic and resource-rich learning environments, social negotiation, multiple perspectives, ownership, and self-regulation (Jonassen, 1999; Wilson, 1996), can be further incorporated into managing organizational knowledge creation processes. Given the similarities and complementary nature of these enablers and conditions, a strong need exists for synthesizing the factors that facilitate effective and efficient learning and knowledge creation. For this problematic inquiry, we addressed two research questions :

When elements and principles of individual and organizational learning interact with each other, more dynamic knowledge creation practices will be promoted.

- ◆ What is the proposed conceptual road map of the learning theory-based knowledge creation process in a supportive environment?
- ◆ What are the common drivers or enablers that contribute to the enhancement of individual and organizational learning as well as organizations' knowledge creation process?

Figure 1 is our concept mapping of related themes for this study based on multiple sources (Nonaka & Takeuchi, 1995; Nonaka, Toyama, & Byosiè, 2001; Song & Chermack, 2008; von Krogh, Ichijo, & Nonaka, 2000). It shows that individuals' experience-based knowledge, with the information they possess or can access, is a starting point for learning to flow within organizations (Nonaka & Takeuchi, 1995; Sessa & London, 2006; Watkins & Marsick, 1993). At the center of the diagram is the integrated concept of individual and organization learning, which we elaborate in this article. When elements and principles of individual and organizational learning interact with each other, more dynamic knowledge creation practices will be promoted. The upper-right component of knowledge creation practices implies that explicit knowledge creation practices can strengthen the components of individuals' knowledge assets and the integration of individual and organizational learning. Nonaka and Takeuchi (1995) emphasize that an organizational knowledge creation practice is a circulative and spiral process that is, once concretized as newly usable knowledge, internalized into members' expertise to reinstate the same cycle. Practically embedded experiences and shared knowledge of working mental models facilitate

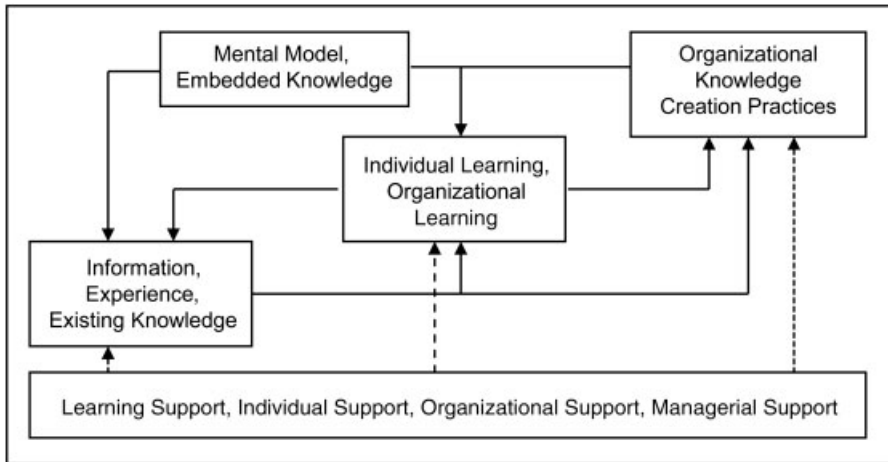


FIGURE 1. INTEGRATED CONCEPT OF LEARNING-BASED KNOWLEDGE CREATION AND ENABLING FACTORS

effective conversion of organizational knowledge at individual levels (Senge, 1990). Finally, all of these learning- and knowledge-related activities in organizations can be facilitated by various organizational support systems represented by dotted lines in Figure 1.

Theories of social capital (Gubbins & Garavan, 2005; Lin, 2001) provide a good basis for promoting knowledge accumulation, member collaboration, and management of learning. Social capital is commonly defined as usable resources available from the network of relationships possessed by individuals or social units (Nahapiet & Goshal, 1998, cited in Gubbins & Garavan, 2005). Social capital theories posit that resource capital within an organization is maximized by strengthening formal and informal relationships: strong ties from formal work relationships to get things done and weak ties to connect people inside and outside the organization to develop larger networks to have access to novel and innovative information. Although scholars differ regarding which resources make up the core of social capital (e.g., shared values, trust, business ideas, financial capital, and power), they agree that locations of the desired resource and members' relationships are to be examined for the effectiveness of knowledge and resource flow (Akdere & Roberts, 2008).

Method

The primary goal of this integrative literature review was sense making for readers of the proposed road map, where learning is embedded in the individual employee's daily tasks as the culture of learning is ingrained in all aspects of work life (Senge, 1990). Torraco (2005) defines the integrative literature review as a research method of generating new knowledge about the topic reviewed. He suggests that researchers accomplish this goal by first critically analyzing strengths and deficiencies of work in the literature,

followed by synthesizing the results into new knowledge. Furthermore, Torracco explains that the latter is commonly done through using one or more of four methods: a research agenda, a taxonomy or classification, an alternative model or conceptual framework, or a metatheory, which elaborates on a body of theory. We used the conceptual framework approach in synthesizing theories of learning and knowledge creation.

The Pennsylvania State University Library Access System, which contains more than 350 interlinked scholarly resources, was used for locating relevant literature. First, to identify relevant books and articles, the following keywords and combinations of them were used: *individual learning*, *learning theory*, *organizational learning*, *organizational learning process*, *learning organization*, *learning culture*, *knowledge conversion*, and *knowledge creation*. Next, three researchers examined the relevance of the source, redundancy of the results, and credibility of the articles, which resulted in sixty-nine articles, four handbooks, six edited books, and nineteen books reviewed. During the process, we regularly exchanged emergent themes from the sources examined. Figure 1 is the result of this work. What follows is the result of our integrative review, which has been organized according to each theme: knowledge workers, individual learning, organizational learning, organizational knowledge creation, and enabling and supportive factors.

Literature Review

Our review of knowledge workers, the individual learning process, the organizational learning process, and organizational knowledge creation answers the first question of how to build a road map of learning theory-based knowledge creation process, in which principles of adult learning and theories of individual and organizational learning are synthesized.

Knowledge Workers

The starting point for our proposed road map is the need for understanding the characteristics of knowledge workers, which leads to examining needs for collaborative and creative work opportunities. Drucker (1999) coined the term *knowledge workers* in 1959 to describe the growing number of workers in the economy who work primarily with information or use knowledge. Intangible assets, such as knowledge of the market, the customers, and technologies, are assumed to be contributive to the development of business intelligence and intellectual capital (Davenport & Prusak, 1998; Gherardi, 2006; Leonard, 1998). Competitive advantages that are gained from working with information and knowledge continuously expand the types of knowledge workers and encourage greater network opportunities for increasing their knowledge bases (Cummings & Worley, 2008; Dixon, 2000; Jones, 2006). In industrialized nations, knowledge workers are assumed to far outnumber all other types of workers.

The literature of information management and adult learning supports that assisting knowledge workers with information and integrating their past

experiences and current knowledge into jobs and tasks can have an enormous impact on their work productivity and learning effectiveness (Gherardi, 2006). Widespread concepts such as knowledge functions (capturing and accessing knowledge), knowledge processes (systematic work performed by professional groups), knowledge management (creating, accumulating, organizing, and disseminating information, expertise, and insights; Rosenberg, 2006), and knowledge organizations (transformation of organizational resources to consumable knowledge services; Davenport & Prusak, 1998) are all examples that support the importance of integrating information into knowledge workers' tasks.

Integrating employees' experiences and current knowledge relevant to target information is also crucial because providing multiple styles and preferences for learning and adjusting the level of symbolic representations are important to the impact of the conversion of individual learning into organizational learning and knowledge creation (Nonaka & Takeuchi, 1995). Bruner (1964) notes that people structure their understanding of the world through action or patterned motor acts, conventionalized imagery and perception, and symbols, such as language, notations, and reason. Research on memory and schema theory also notes that mental reconstruction (sense making) is more idiosyncratic and semantic than faithfully representing physical forms (Bruner & Bornstein, 1989). Although symbols are economical ways of representing knowledge, more concrete examples, feedback, and tactile experiences are necessary for people who do not yet possess well-developed symbolic systems.

Individual Learning Process

Individuals act as agents of organizational learning (Argyris & Schön, 1996; Brown & Duguid, 2001; Nonaka & Takeuchi, 1995). Thus, a systemic framework for applying major concepts and principles of individual learning to organizational learning is important. Driscoll (2005) gives a commonly accepted view of learning as a persisting change in human performance or performance potential, that is, a lifelong activity, which can happen in formal instructional settings or through incidental experiences. She also notes that viable learning theories must provide clear and sustainable answers to questions of results (changes in performance to be explained), means (by what processes the results are brought about), and inputs (what triggers the processes to occur and what resources or experiences form the basis of learning). Driscoll (2005, 2007) lists theories of behaviorism, cognitive information processing, schema theory, cognitive load theory, situated learning, nativists' view of cognitive and knowledge development, interactional theories of cognitive development, motivation and self-regulation, and constructivism as core learning theories that matter for instruction and education (see Driscoll, 2005 for how each theory defines learning results and what inputs are essential for appropriate instruction). Although changes in the process of acquiring new knowledge or a higher level of learning capacity can be explained well by each learning theory, what is needed to improve the literature is extending what we know about individual learning to the organizational level.

According to knowledge conversion theory (Nonaka & Takeuchi, 1995), individuals' dynamic social practices compose the core of knowledge creation and conversion practices. In this framework, firms are viewed as entities in need of leveraging distributed knowledge sources. Members' negotiations frequently determine which knowledge is shared (Tsoukas, 1996). This view of knowledge-based firms allows one to amalgamate different theories of learning into common processes of individual learning that focus more on the incidental and action-driven nature of organizational learning. In the sections that follow, four related processes of learning—adaptive, generative, transformative, and reflective learning—are presented as a conceptual framework for applying major concepts and principles of various learning theories.

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Adaptive Learning Process

The primary source of the knowledge creation process is the diversity of individuals' knowledge and experience (Nonaka & Takeuchi, 1995). Each employee brings a wealth of experience, expertise, and needs for working with more knowledge, which becomes the foundation for the dynamic knowledge-sharing and knowledge-creating process. In this learning process, individuals actively interact with organizational environments. Views of learning that can apply here include employees' active cognitive development through assimilation (Ausubel, 1980), refinement of schema (Rumelhart, 1980), internalization of external social experiences (Vygotsky, 1978), participation and engagement in communities of practice (Lave & Wenger, 1991), integration of process ownership, multiple perspectives, social negotiation, and authentic environments of constructivism (Jonassen, 1999). Argyris and Schön (1978) point out that members' continuous learning activities can be initiated and geared up by individuals' adaptive learning manner. When members are exposed to an atmosphere of sharing ideas, their tacit knowledge can be organized for interpersonal sharing. The literature of transactive memory (Austin, 2003) and shared mental models (Ilgen, Hollenbeck, Johnson, & Jundt, 2005) provides frameworks for examining members' cognitive, affective, and behavioral proximities and how they affect team performance.

Generative Learning Process

The generative learning process, which is more related to the cognitive learning process, is believed to create new skills, knowledge, and applicable methods toward the organizational level (Sessa & London, 2006). Employees' alliances with other members for teamwork and cross-functional responsibilities convert accumulated individuals' knowledge into the organizational explicit knowledge—called *externalization*—through the process of circulative social interactions (Nonaka & Takeuchi, 1995). During this process of social learning and interactions (Bandura, 1986; Lave & Wenger, 1991), individuals' tacit knowledge is shared and embedded into the organizational knowledge repository, shaping organizational mental models (Nonaka &

Takeuchi, 1995; Sessa & London, 2006). Individuals frequently identify problematic issues during this generative learning process, which forms the basis of continuous organizational learning and changes (Ramanujam, 2003; Sessa & London, 2006). To promote generative learning, researchers emphasize dynamic organizational supports and cross-functional interactions to cope with environmental changes (Garvin, 1993).

Transformative Learning Process

While individuals try to conform or cogenerate new ideas, concepts, and processes following the adaptive and the generative process, they become the primary initiator and creator of justifiable explicit knowledge. When knowledge is gained as the result of learning transfer to workplace applications, this process becomes the major route to building up organizational knowledge assets. Organizational culture has been proposed as the most critical element to encourage performance-oriented actions in the workplace (Nonaka, Peltokorpi, & Tomae, 2005; Nonaka & Takeuchi, 1995; Sessa & London, 2006). Studies of training transfer also support that organizational climate and design of instruction simulating work problem solving enhance successful transfer of learning (Holton & Baldwin, 2003; Lim, 2000). From an organizational perspective, more programmatic and systemic management of knowledge and learning transfer involves the process of transformative learning management focusing on people-related factors (e.g., learners, peers, supervisors) as well as work environment factors (e.g., work systems, performance support technologies) before, during, and after an instructional intervention (Broad & Newstrom, 1996; Lim, 2000). Most important, individuals reconstruct their learned knowledge through the transformative learning process, and validation of their existing insights recognized or adopted by others gains the status of collective knowledge to be leveraged (Mezirow, 1991, 1997). According to Kreber and Cranton (2000), combining experience- and research-based knowledge plays a significant role. This transformative learning process encourages the practice of knowledge justification, which promotes the creation of transferable and applicable knowledge in the workplace.

Reflective Learning Process

Most modern theories of learning promote the concept of reflective learning as essential for deep and applicable learning (Brockbank, McGill, & Beech, 2002). According to Dewey (1993), human reflection is the process by which individuals make meaning from the constructive experiences, interpersonal collaborations, and interactions with environments. Schön (1983) proposed two valuable types of human reflection: reflection-in-action, a simultaneous reflection through which the individual is consciously monitoring the problem-solving process and modifying the sequential actions instantaneously, and reflection-on-action, the reflective learning process that occurs after an event and leads to change in the future series of the actions. Principles, such as *think like members of the profession, view situations from multiple perspectives, consider alternative or counter per-*

spectives, and *use evidence for making decisions* are exemplary behaviors (Kitchener & King, 1990). These concepts and principles of individuals' reflective learning process form the basis of progressive actions and become the foundation for suitable changes and organizational transformation. Organizations must be cognizant of the fact that reflective inquiries take time, commitment, and practice (Hartog, 2002).

Organizational Learning Process

Organizational learning has become quite popular since the 1990s, although the first mention of the concept dates back about 50 years (March & Simon, 1958, as cited by Easterby-Smith, Snell, & Gherardi, 1998). In the 1970s, the concept was presented as a discipline by Argyris and Schön (1978). Near the end of the 1970s, Argyris made great efforts to integrate actionable learning and collaborative organizational learning with a double-loop learning concept where the primary focus shifted from the single-loop learning of correcting errors (e.g., goals, values, rules, and plans) toward directly questioning and shaping them (Argyris, 1977; Argyris & Schön, 1978, 1996). Argyris and Schön (1978) defined organizational learning process as follows: "Organizational learning occurs when members of the organization act as learning agents for the organization, responding to changes in the internal and external environments of the organization by detecting and correcting errors in organizational theory-in-use, and embedding the results of their inquiry in private images and shared map of organization" (p. 29).

Levitt and March (1988) presented a more practice-focused definition of organizational learning: "Organizational learning means the learning from direct experience, how organizations learn from the experience of others, and how organizations develop conceptual frameworks or paradigms for interpreting that experience" (p. 319).

Huber (1991, 1996) gave a more management-centric view on organizational learning, defining it as knowledge acquisition, information and knowledge distribution, knowledge sharing and interpretation, and integrated organizational knowledge retention and creation. From these definitions, major themes of organizational learning are found: (1) the organizational learning process should be aligned with the foundation of individuals' learning processes; (2) organizational learning occurs based on the organization's previous experiences; (3) the organizational learning process needs to focus on structuring and integrating concepts of knowledge and information; (4) organizational learning focuses more on the learning and knowledge leveraging practices; and (5) the effectiveness of the organizational learning process depends on the levels of learning and knowledge transformation, retention, and creation within the organization. The key factor of organizational learning is how to leverage and motivate the learning process and practice at broader levels in the organization. Examining the literature also makes clear that organizational learning is a more process- and system-focused approach; thus, a process for fostering the active interpersonal learning practices at the broader organizational level is critical (Senge,

1990; Watkins & Marsick, 1993). Therefore, positioning the characteristics and processes of individual learning as a triggering and shaping point of collaborative learning and sharing practices is warranted.

A related concept that needs to be distinguished is learning organization. The concept of a learning organization has been largely defined as a structure reflective of effective environmental aspects that lead to and promote the continuous organizational learning process (Garvin, 1993; Senge, 1990; Jensen, 2005; Tsang, 1997; Watkins & Marsick, 1993, 1996). Slater and Narver (1994) stated that a learning organization continuously acquires, processes, and disseminates knowledge about markets, products, technologies, and business processes, and this knowledge is often based on experience, experimentation, and information provided by customers, suppliers, competitors, and other sources. More recently, Jensen (2005) defined it more broadly as “an organization that is organized to scan for information in its environment, by itself creating information and promoting individuals to transform information into knowledge and coordinate this knowledge between the individuals so that new insight is obtained” (p. 61).

Organizational Knowledge Creation: The Knowledge Conversion Theory

To join the process of individual and organizational learning together, a systemic and systematic management of organizational knowledge is helpful. Human knowledge can be categorized into two simple types: tacit and explicit knowledge (Nonaka & Takeuchi, 1995; Nonaka et al., 2001). The key function of the effective knowledge-creating process depends on the interactions between these two types of knowledge, a process called *knowledge conversion* (Nonaka, 1991, 1994; Nonaka & Takeuchi, 1995). The knowledge conversion process has four modes: (1) socialization (from tacit to tacit), (2) externalization (from tacit to explicit), (3) combination (from explicit to explicit), and (4) internalization (from explicit to tacit).

Socialization

Socialization is the informal interaction of bringing together tacit knowledge through diverse perspectives and shared experiences (Nonaka et al., 2001). The basic assumption of this process is that tacit knowledge can be acquired through experience even without language—for example, through on-the-job-training and apprenticeship. How to share and articulate individuals’ tacit knowledge is the key concept of this process (Nonaka, 1994). During socialization, the first process of knowledge conversion, the shared individuals’ tacit knowledge can be converted into new concepts and task-related perception, which can create new tacit knowledge. In this process, informal and formal interactions through observation, imitation, and daily informal dialogue are required for more dynamic knowledge sharing and acquisition (Nonaka & Takeuchi, 1995). In the workplace, sharing and spending time together serve as critical catalysts for encouraging the sharing of collaborative experience. The socialization process occurs by working collaboratively in the same organizational culture and during informal social

meetings among group members, and with customers, suppliers, and competitors. The principal components of a dynamic knowledge-sharing process are the diversity, continuous interactions, supportive collaborations, and boundary-crossing interactions of the individual group members.

Externalization

The second process of knowledge conversion is externalization: when individual tacit knowledge is justified with others, it can be shared by others (Nonaka, Toyama, & Konno, 2000). Articulating and configuring shared tacit knowledge into organizational explicit knowledge is a key to the externalization process (Nonaka & Takeuchi, 1995). During this process, formal meetings and interactions are used to codify and create applicable concepts. In this mode, continuous and collaborative communication through symbols (e.g., metaphors, figures, diagrams, and analogies) based on the inductive and deductive thinking process is required to lead to mutually understandable knowledge conceptualization and articulation (Nonaka, 1991, 1994; Nonaka & Takeuchi, 1995; Nonaka et al., 2000). To promote more effective externalization, capturing problem-solving patterns of subject matter experts and sharing lessons learned from the relevant previous projects are suggested. Individuals' tacit knowledge is conceptualized mostly by the expression of its language, and the central process in creating explicit concepts is coming up with language to communicate new insights and guide new perceptions, which lead to fostering reflection and interaction among individuals (Nonaka & Takeuchi, 1995; von Krogh, 1998; Nonaka & Nishiguchi, 2001). When tacit knowledge is made explicit, "knowledge is crystallized, thus allowing it to be shared by others, and it becomes the basis of (the organization's) new knowledge" (Nonaka et al., 2000, p. 9).

The principal components of a dynamic knowledge-sharing process are the diversity, continuous interactions, supportive collaborations, and boundary-crossing interactions of the individual group members.

Combination

Combination is "the process of connecting discrete elements of explicit knowledge into a set of explicit knowledge that is more complex and systematic than any of its parts" (Nonaka et al., 2001, p. 497). The combination process involves gathering, organizing, editing, categorizing, and synthesizing newly converted explicit knowledge into existing organizational knowledge, such as documents, norms, routines, and rules, and subsequently disseminating applicable conceptualized organizational knowledge. Using accurate terms, applying understandable figures and diagrams, and having a management support system are all keys to the effective combination process (Nonaka, 1994; Nonaka & Takeuchi, 1995; Nonaka et al., 2000).

Internalization

Internalizing refined organizational knowledge such as newly implemented processes and changed norms into individual learning is the last

component of this spiral organizational knowledge creation process (Nonaka & Takeuchi, 1995; Nonaka et al., 2000, 2001). Through this process of internalization, knowledge that is created is shared throughout the whole organization, resulting in “members’ broadened, extended, and reframed tacit knowledge” (Nonaka et al., 2001, p. 497). In this mode, individuals’ experimental experiences play a major role, which is related to the concept of learning by doing, and “when experiences through socialization, externalization, and combination are internalized into individuals’ tacit knowledge bases in the form of shared mental models or technical know-how, they become valuable assets at organizational levels” (Nonaka & Takeuchi, 1995, p. 69). This tacit knowledge accumulated at the individual level can trigger a new spiral of knowledge creation when the group members share this knowledge through socialization again (Nonaka et al., 2000).

If we believe in the value of organizational learning and the importance of integrating individual learning theories and organizational knowledge management, promoting individual members’ adaptive, generative, transformative, and reflective learning practices, as well as facilitating the process and practices of socialization, externalization, combination, and internalization, seems to be the right thing to do. Such a holistic, process-oriented, and spiral nature of organizational learning and knowledge creation will be feasible only when proper support systems are in place.

Enabling and Supportive Factors

Our integrative literature review of enabling and supportive factors answers the second research question of important drivers and enablers of individual learning, organizational learning, and the organizational knowledge creation process. Table 1 shows the comparison of supportive factors at different levels (individual, group and organizational, and management) from the literature on learning organization and the knowledge creation process. It also synthesizes commonalities from different system levels at the bottom, which summarizes the theme of supportive systems illustrated in Figure 1.

Reviewing the literature on individual learning, organizational learning, and the organizational knowledge creation process reveals that to link learning and knowledge within organizations requires the following support systems: continuous learning support, team- or community-based collaboration support, systemic organizational support, and managerial support. Among these, Merx-Chermin and Nijhof (2005) claim that the most critical factor is the continuous and reflective organizational learning process. Spiral knowledge growth in an organization always takes place through individuals’ continuous learning practices and collaborative organizational learning processes. The literature on learning organization and knowledge creation enablers concurs that team-based collaboration (Watkins & Marsick, 1993, 1996), supportive culture for continuous learning (Senge, 1990), systematic support for interdisciplinary learning (Nonaka & Takeuchi, 1995), and a strategic alignment of learning and performance solutions leveraging technologies and leadership (Rosenberg, 2006) are indispensable for continuous learning processes to happen.

TABLE 1 ENABLING AND SUPPORTIVE FACTORS AT VARIOUS SYSTEM LEVELS

	SUPPORTIVE LEARNING CULTURE	KNOWLEDGE CREATION ENABLERS
Individual level	Continuous learning	Learning process
	Inquiry and dialogue	Continuous communication
	Double-loop learning	Reflective thinking
	(Argyris, 1977; Argyris & Schön, 1978, 1996; Senge, 1990; Watkins & Marsick, 1993, 1996)	Individual diversity (Nonaka, 1994; Nonaka & Takeuchi, 1995; von Krogh et al., 2000)
Organizational level	Team-based learning	Interdepartmental collaboration
	Dynamic collaboration	Dynamic knowledge sharing
	Organizational learning	Continuous knowledge application
	Information processing with the outside	Collaboration with the outside
	Systematic connection (Garvin, 1993, 2000; Senge, 1990; Sessa & London, 2006; Tsang, 1997; Jensen, 2005; Marquardt, 2002; Watkins & Marsick, 1993, 1996)	(Nonaka & Takeuchi, 1995; Nonaka et al., 2000, 2005; von Krogh et al., 2000)
Management and system levels	Supportive leadership	Interpersonal trust
	Empowerment	Supportive leadership
	Building trust	Creating vision and a supportive climate
	Providing resources	Knowledge process and domain: Leverage/expand/appropriate/probe
	Supportive learning opportunity	Information systems
	Technology systems	Knowledge management systems
	(Carroll, Rudolph, & Hatakenaka, 2005; Garvin, 2000; Gilley & Maycunich, 2000; Watkins & Marsick, 1993, 1996)	(Huber, 1991; Nonaka & Takeuchi, 1995; Nonaka, Takeuchi & Umemoto, 1996; Nonaka et al., 2000; von Krogh et al., 2000, 2001)
Mutual commonalities	Continuous learning process	
	Diversity and dynamic thinking process	
	Interpersonal trust-based communication	
	Reflective thinking and evaluation	
	Collaborative learning and knowledge sharing	
	Group dynamics	
	Group collaboration, leadership, empowerment, and resource system	
	Technology: E-learning, knowledge management, performance support, and information systems	

Discussion

Our literature review seeks to create an integrative conceptual flow map of individual and organizational learning facilitated by culture and management system enablers. To do so, we have used the procedure suggested by the integrative literature review method, which started with critical analysis followed by synthesis of work into a conceptual framework (Torraco, 2005; Webster & Watson, 2002). Figure 1 illustrates that the integration of individual and organizational learning should start from a solid understanding of knowledge workers and their needs for working with information and through collaboration. It also shows that the process of knowledge creation can be used to integrate individual and organizational learning, and the entire flow is best facilitated when proper support systems are in place. Table 1 summarizes that such support systems should include multiple elements, such as leadership, encouragement of collaborative work and reflective thinking, information and technology resources, and support for diversified and creative thinking. When these components are present in an organization, the process of integrating individual and organizational learning will look more like the flow of learning and knowledge illustrated in Figure 2.

Figure 2 shows that all components of the knowledge creation practices are linked and supported by each mode of individuals' learning processes: adaptive, generative, transformative, and reflective. Although the terms of learning theories have not been employed in the theory of knowledge conversion, according to our integrative review, individuals' four types of learning processes and organizations' four types of knowledge creation practices seem to move in parallel, with tacit knowledge being converted to organizational explicit knowledge and vice versa. And the flow and alignment between them can improve when multiple but structured system enablers are in place.

This conceptual framework supports the literature that organizational knowledge creation and learning start with members' expertise and information, and sharing of such tacit knowledge increases when individual members socialize or try to adapt by conforming to or coconstructing new ideas (Nonaka & Takeuchi, 1995). Organizational knowledge at this early state can be redundant and nonnormative (Nonaka & Takeuchi, 1995). Validation of ideas occurs through individuals' generative learning whereby individuals' cognition process in the social context transforms the shared informative but tentative knowledge into meaningful and more practical knowledge, which characterizes knowledge externalization (Nonaka et al., 2005; Sessa & London, 2006). For externalized knowledge to be applied in the workplace, individuals' transformative learning should happen through justifying the applicability and legitimacy of new ideas. Such experienced knowledge (both successful and failed) through transformative learning validates the value of rules and norms created. For further adoption of such knowledge, it should be embedded into the organizational nonverbal climate and underlying norms (i.e., mental models) through reflective practices.

Organizational Learning and Knowledge Creation | Individual Learning Process

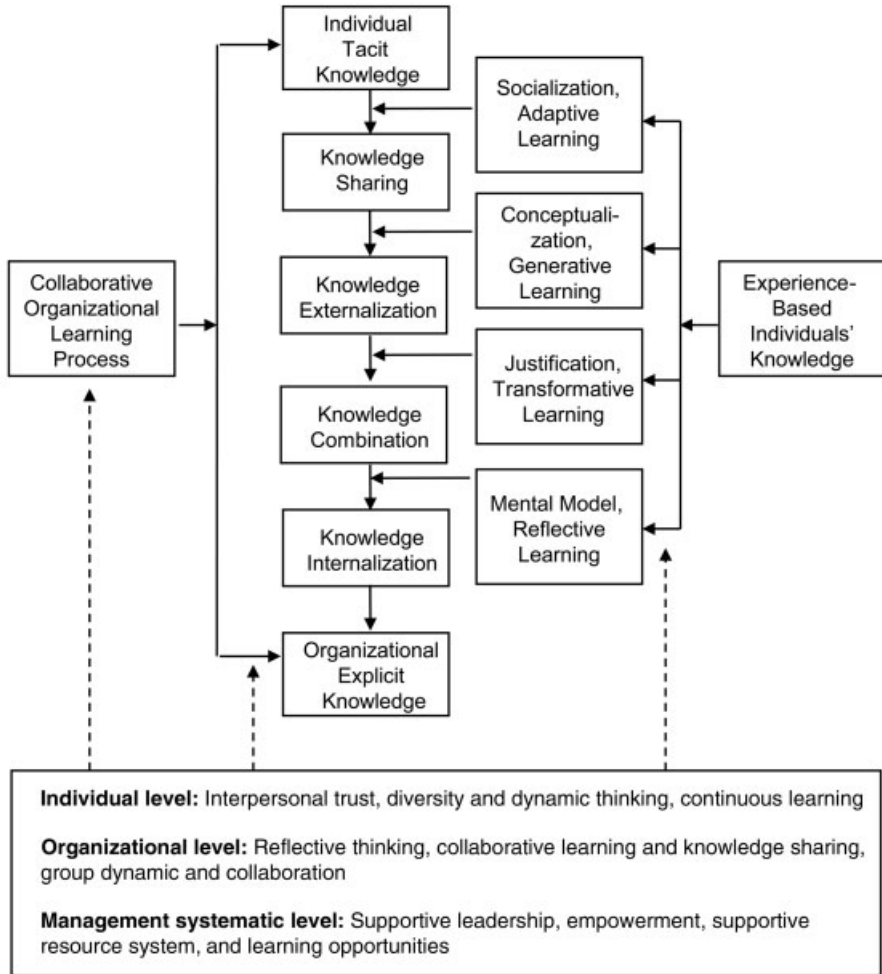


FIGURE 2. LEARNING-BASED KNOWLEDGE CREATION IN A SUPPORTIVE ORGANIZATIONAL CULTURE

Driven by various organizational support systems, knowledge workers start or join the cycle of knowledge refinement.

Figure 2 also highlights that organizational multifactor supports could stimulate and encourage a more dynamic collaboration-based organizational learning process among the group members in the organization (Watkins & Marsick, 1993). This collaborative organizational learning process would support all the phases and circulative process of organizational knowledge creation practices (Nonaka & Takeuchi, 1995; von Krogh et al., 2000). In addition, from the adult learning standpoint (Hartog, 2002), individuals' experience and their preexisting knowledge drive the applica-

tion- and practice-oriented learning processes. Systematic supports should be promised in the form of continuous inquiry, communication, and learning; the collaborative reflective thinking process and creative knowledge sharing; and strategic leadership, knowledge resource system, and chances of empowerment within organizations (Watkins & Marsick, 1993).

System support factors must be actively engaged simultaneously at the individual and organizational levels, allowing diverse perspectives and creativity to prosper in individuals' learning processes (Senge, 1990; Watkins & Marsick, 1993); securing interpersonal trust among organizational members in their communication channels (Nonaka & Takeuchi, 1995; von Krogh et al., 2000); facilitating reflective thinking and evaluation to improve current work practices and performance (Preskill & Torres, 1999; Sessa & London, 2006);

Driven by various organizational support systems, knowledge workers start or join the cycle of knowledge refinement.

establishing an atmosphere encouraging collaborative problem solving (Marquardt, 1996, 2002); seeking group dynamics to vitalize each sector of the organization (Jones, 2006); encouraging group collaboration, self-initiation, and empowerment; and collaboratively building a shared resource system (Garvin, 2000; Senge, 1990; Marsick & Watkins, 1999; Watkins & Marsick, 1993). One critical consideration is how to strategically use human resource development and performance technology systems to promote those factors and enablers for organizational learning and knowledge creation.

Our proposed integrative conceptual flow map of individual and organizational learning can serve as a road map for encouraging desired individual and collaborative behaviors in such systems.

Implications for Practice and Future Research. To date, many interventions designed and practiced by human resource development or performance technology professionals are based on many concepts and principles of individual learning theories and human behaviors (Haney, 2006), with applications to work and learning left to be desired at the organizational level. However, to bridge the learning application with expected outcomes, more explicit and systematic management of learning flow should be adopted. Incorporating the theoretical mechanism of organizational knowledge creation can strengthen the conversion of individual learning into organizational learning and assist knowledge workers' learning processes with the systematic understanding of emergent organizational knowledge (Song & Chermack, 2008). Furthermore, the holistic framework proposed in this article allows practitioners to examine suggested cultural and system components that encourage not only supportive learning organization but also dynamic knowledge creation activities.

Limitation and Future Research. The primary method of this research was the integration of various themes based on the holistic literature review. Theoretically integrated concepts (i.e., metatheory) could be the theoretical foundation for future research; however, from a practical standpoint, the nature of the literature review research has a limitation in providing the how-to perspective.

Integrating the vast knowledge base of learning theories with organizational learning is a daunting but worthwhile task. The synthesis work and created relationships among proposed constructs are largely heuristic in this study. In future research, the suggested factors of each theme of individuals' learning, knowledge creation practice, and supportive organizational culture need to be empirically tested. To do so, as an initial attempt to verify the suggested learning-based knowledge creation framework, a more qualitative approach can be useful for identifying model behaviors within each construct. Case study or observation can be used for such purposes. The integrative perspectives extracted from multiple themes also present opportunities for exploring questions related to enablers—for example, To what extent and how does the knowledge management and repository system influence the dynamic knowledge creation process? To what extent and how does interpersonal trust influence the collaborative organizational learning process? To what extent and how does supportive leadership influence the continuous learning and knowledge creation process? In answering how knowledge and advancement of individual learning can be better integrated into organizational learning, how the literature of organizational learning and organizational knowledge creation can complement each other, and how organizations should promote and engage active, reflective, and collaborative learning processes, our proposed conceptual framework based on the integrative literature review is an attempt of theoretical sense making.

References

- Akdere, M., & Roberts, P. (2008). Economics of social capital: Implications for organizational performance. *Advances in Developing Human Resources, 10*(6), 802–816.
- Argyris, C. (1977). Double loop learning in organizations. *Harvard Business Review, 55*(5), 115–125.
- Argyris, C., & Schön, D. (1978). *Organizational learning: A theory of action perspective reading*. Reading, MA: Addison-Wesley.
- Argyris, C., & Schön, D. (1996). *Organizational learning II: Theory, method and practice* (Vol. 1). Reading, MA: Addison-Wesley.
- Austin, J. R. (2003). Transactive memory in organizational groups: The effects of content, consensus, specialization, and accuracy on group performance. *Journal of Applied Psychology, 88*(5), 866–878.
- Ausubel, D. P. (1980). Schemata, cognitive structure, and advance organizers: A reply to Anderson, Spiro, and Anderson. *American Educational Research Journal, 17*(3), 400–404.
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Upper Saddle River, NJ: Prentice Hall.
- Broad, M., & Newstrom, J. (1996). *Transfer of training*. Reading, MA: Addison-Wesley.
- Brockbank, A., McGill, I., & Beech, N. (2002). Reflective learning and organization. In A. Brockbank, I. McGill, & N. Beech (Eds.), *Reflective learning in practice* (pp. 15–17). London: Gower.
- Brown, J. S., & Duguid, P. (2001). Knowledge and organization: A social-practice perspective. *Organizational Science, 12*(2), 198–213.
- Bruner, J. S. (1964). The course of cognitive growth. *American Psychologist, 19*, 1–15.
- Bruner, J. S. (1997). Celebrating divergence: Piaget and Vygotsky. *Human Development, 40*, 63–73.

- Bruner, J. S., & Bornstein, M. H. (1989). *Interaction in human development*. Mahwah, NJ: Erlbaum.
- Carroll, J. S., Rudolph, J. W., & Hatakenaka, S. (2005). Learning from organizational experience. In M. Easterby-Smith & M. A. Lyles (Eds.), *Handbook of organizational learning and knowledge management* (pp. 575–600). Malden, MA: Blackwell.
- Cummings, T. G., & Worley, C. G. (2008). *Organizational development and change* (9th ed.). Mason, OH: Thomson South-Western.
- Davenport, T., & Prusak, L. (1998). *Working knowledge: How organizations manage what they know*. Boston: Harvard Business School Press.
- Dewey, J. (1993). *How we think: A restatement of the relation of reflective thinking to the educative process*. Boston: Houghton Mifflin.
- Dixon, N. M. (2000). *Common knowledge: How companies thrive by sharing what they know*. Boston: Harvard Business School Press.
- Driscoll, M. (2005). *Psychology of learning for instruction* (3rd ed.). Needham Heights, MA: Allyn & Bacon.
- Driscoll, M. (2007). Psychological foundations of instructional design. In R. Robert & J. Dempsey (Eds.), *Trends and issues in instructional design and technology* (2nd ed., pp. 36–44). Upper Saddle River, NJ: Merrill Prentice Hall.
- Drucker, P. F. (1999). *Management challenges for the 21st century*. Burlington, MA: Butterworth-Heinemann.
- Easterby-Smith, M., Snell, R., & Gherardi, S. (1998). Organizational learning: Diverging communities of practice? *Management Learning*, 29(3), 259–272.
- Ellinger, A. D., Ellinger, A. E., Yang, B., & Howton, S. W. (2002). The relationship between the learning organization concept and firms' financial performance: An empirical assessment. *Human Resource Development Quarterly*, 13(1), 5–21.
- Garvin, D. A. (1993). Building learning organization. *Harvard Business Review*, 71(4), 78–91.
- Garvin, D. A. (2000). *Learning in action: A guide to putting the learning organization to work*. Boston: Harvard Business School Press.
- Gherardi, S. (2006). *Organizational knowledge: The texture of workplace learning*. Malden, MA: Blackwell.
- Gilley, J. W., & Maycunich, A. (2000). *Organizational learning, performance and change: An introduction to strategic human resource development*. Cambridge, MA: Perseus.
- Gubbins, C., & Garavan, T. N. (2005). Studying HRD practitioners: A social capital model. *Human Resource Development Review*, 4(2), 189–218.
- Haney, D. (2006). Knowledge management, organizational performance, and human performance technology. In J. A. Pershing (Ed.), *Handbook of human performance technology: Principles, practices, potential* (3rd ed., pp. 619–639). San Francisco: Jossey-Bass/Pfeiffer.
- Hartog, M. (2002). Becoming a reflective practitioner: A continuing professional development strategy through humanistic action research. *Business Ethics: A European Review*, 11, 233–243.
- Holton, E. F., & Baldwin, T. T. (2003). Making transfer happen: An action perspective on learning transfer systems. In E. F. Holton & T. T. Baldwin (Eds.), *Improving learning transfers in organizations* (pp. 3–15). San Francisco: Jossey-Bass.
- Huber, G. P. (1991). The contributing processes and the literatures. *Organization Science*, 2(1), 88–115.
- Huber, G. P. (1996). Organizational learning: A guide for executives in technology-critical organizations. *International Journal of Technology Management*, 11(7/8), 821–832.
- Ilgén, D. R., Hollenbeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in organizations: From input-process-output models to IMOI models. *Annual Review of Psychology*, 56, 517–543.
- Jensen, P. E. (2005). A contextual theory of learning and the learning organization. *Knowledge and Process Management*, 12(1), 53–64.
- Jonassen, D. H. (1999). Designing constructivist learning environments. In C. M. Reigeluth (Ed.), *Instructional-design theories and models* (pp. 215–239). Mahwah, NJ: Erlbaum.

- Jones, G. R. (2006). *Organizational theory, design, and change* (5th ed.). Upper Saddle River, NJ: Pearson Education.
- Kitchener, K. S., & King, P. M. (1990). The reflective judgment model: Ten years of research. In M. L. Commons et al. (Eds.), *Adult development: Models and methods in the study of adolescent and adult thought* (Vol. 2, pp. 63–78). Westport, CT: Praeger.
- Kontoghiorghes, C., Awbrey, S. M., & Feurig, P. L. (2005). Examining the relationship between learning organization characteristics and change adaptation, innovation, and organizational performance. *Human Resource Development Quarterly*, 16(2), 185–211.
- Kreber, C., & Cranton, P. A. (2000). Exploring the scholarship of teaching. *Journal of Higher Education*, 71(4), 476–495.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.
- Leonard, D. (1998). *Wellsprings of knowledge: Building and sustaining the sources of innovation*. Boston: Harvard Business School Press.
- Levitt, B., & March, J. G. (1988). Organizational learning. *Annual Review of Sociology*, 14, 319–340.
- Lim, D. H. (2000). Training design factors influencing transfer of training to the workplace within an international context. *Journal of Vocational Education and Training*, 52(2), 243–257.
- Lin, N. (2001). *Social capital: A theory of social structure and action*. Cambridge: Cambridge University Press.
- Marquardt, M. J. (1996). *Building the learning organization*. New York: McGraw-Hill.
- Marquardt, M. J. (2002). *Building the learning organization: Master the five elements for corporate learning*. Palo Alto, CA: Davis-Black.
- Marsick, V. J., & Watkins, K. E. (1999). *Facilitating learning organization: Making learning count*. Aldershot, England: Gower.
- McLean, G. N. (2006). National human resource development: A focused study in transitioning societies in the developing world. *Advances in Developing Human Resources*, 8(1), 3–11.
- Merx-Chermin, M., & Nijhof, W. J. (2005). Factors influencing knowledge creation and innovation in an organization. *European Industrial Training*, 29(2/3), 135–148.
- Mezirow, J. (1991). *Transformative dimensions of adult learning*. San Francisco: Jossey-Bass.
- Mezirow, J. (1997). Transformation theory out of context. *Adult Education Quarterly*, 48(1), 60–62.
- Noe, R. (2004). *Employee training and development* (3rd ed.). New York: McGraw-Hill/Irwin.
- Nonaka, I. (1991). The knowledge-creating company. *Harvard Business Review*, 69(6), 96–105.
- Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, 5(1), 14–37.
- Nonaka, I., & Nishiguchi, T. (2001). Knowledge emergence. In I. Nonaka & T. Nishiguchi (Eds.), *Knowledge emergence: Social, technical, and evolutionary dimensions of knowledge creation* (pp. 3–9). New York: Oxford University Press.
- Nonaka, I., Peltokorpi, V., & Tomae, H. (2005). Strategic knowledge creation: The case of Hamamatsu Photonics. *International Journal of Technology Management*, 30(3/4), 248–264.
- Nonaka, I., & Takeuchi, H. (1995). *The knowledge creating company: How Japanese companies create the dynamic of innovation*. New York: Oxford University Press.
- Nonaka, I., Takeuchi, H., & Umemoto, K. (1996). A theory of organizational knowledge creation. *International Journal of Technology Management*, 11(7/8), 833–845.
- Nonaka, I., Toyama, R., & Byosièrè, P. (2001). A theory of organizational knowledge creation: Understanding the dynamic process of creating knowledge. In M. Dierkes, A. B. Antal, J. Child, & I. Nonaka (Eds.), *Handbook of organizational learning and knowledge* (pp. 491–517). New York: Oxford University Press.
- Nonaka, I., Toyama, R., & Konno, N. (2000). SECI, Ba and leadership: A unified model of dynamic knowledge creation. *Long Range Planning*, 33(1), 5–34.

- Preskill, H., & Torres, T. T. (1999). The role of evaluation enquiry in creating learning organizations. In M. Easterby-Smith, J. Burgoyne, & L. Araujo (Eds.), *Organizational learning and learning organization: Developments in theory and practices* (pp. 92–114). Thousand Oaks, CA: Sage.
- Ramanujam, R. (2003). The effects of discontinuous change on latent errors in organizations: The moderating role of risk. *Academy of Management Journal*, 46(5), 608–617.
- Rosenberg, M. (2006). *Beyond e-learning: Approaches and technologies to enhance organizational knowledge, learning, and performance*. San Francisco: Jossey-Bass/Pfeiffer.
- Rumelhart, D. E. (1980). Schemata: The building blocks of cognition. In R. J. Spiro, B. C. Bruce, & W. F. Brewer (Eds.), *Theoretical issues in reading comprehension*. Mahwah, NJ: Erlbaum.
- Schön, D. (1983). *How professionals think in action*. New York: Basic Books.
- Senge, P. M. (1990). *The fifth discipline: The art and practice of the learning organization*. New York: Doubleday Currency.
- Sessa, V. I., & London, M. (2006). *Continuous learning in organizations: Individual, group, and organizational perspectives*. Mahwah, NJ: Erlbaum.
- Slater, S. F., & Narver, J. C. (1994). Market orientation, customer value, and superior performance. *Business Horizons*, 37(2), 22–28.
- Song, J. H., & Chermack, T. J. (2008). A theoretical approach to the organizational knowledge formation process: Integrating the concepts of individual learning and learning organization culture. *Human Resource Development Review*, 7(4), 424–442.
- Swanson, R. A. (1995). Human resource development: Performance is the key. *Human Resource Development Quarterly*, 6(2), 207–213.
- Swanson, R. A. (2007). *Analysis for improving performance: Tools for diagnosing organization and documenting workplace expertise* (2nd ed.). San Francisco: Berrett-Koehler.
- Swanson, R. A., & Holton, E. F. (2001). *Foundations of human resource development*. San Francisco: Berrett-Koehler.
- Torraco, R. J. (2005). Writing integrative literature reviews: Guidelines and examples. *Human Resource Development Review*, 4(3), 356–367.
- Tsang, E. W. K. (1997). Organizational learning and the learning organization: A dichotomy between descriptive and prescriptive research. *Human Relations*, 50(1), 73–89.
- Tsoukas, H. (1996). The firm as a distributed knowledge system: A constructivist approach. *Strategic Management Journal*, 17, 11–25.
- Tsoukas, H., & Mylonopoulos, N. (2004). Introduction: Knowledge construction and creations in organizations. *British Journal of Management*, 15(S1), S1–S8.
- von Krogh, G. (1998). Care in knowledge creation. *California Management Review*, 40(3), 133–153.
- von Krogh, G., Ichijo, K., & Nonaka, I. (2000). *Enabling knowledge creation: How to unlock the mastery of tacit knowledge and release the power of innovation*. New York: Oxford University Press.
- von Krogh, G., Nonaka, I., & Aben, M. (2001). Making the most of your company's knowledge: A strategic framework. *Long Range Planning*, 34, 421–439.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Watkins, K. E., & Marsick, V. J. (1993). *Sculpting the learning organization: Lessons in the art and science of systemic change*. San Francisco: Jossey-Bass.
- Watkins, K. E., & Marsick, V. J. (1996). *In action: Creating the learning organization*. Alexandria, VA: American Society for Training and Development.
- Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly*, 26(2), xiii–xxiii.
- Wilson, B. G. (1996). What is a constructivist learning environment? In B. G. Wilson (Ed.), *Constructivist learning environments: Case studies in instructional design*. Upper Saddle River, NJ: Educational Technology Publications.

Yang, B., Watkins, K. E., & Marsick, V. J. (2004). The construct of the learning organization: Dimensions, measurement, and validation. *Human Resource Development Quarterly*, 15(1), 31-55.

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