An Exploration of Communities of Practice: From Lave and Wenger's Seminal Work to a U.S. Government Agency's Knowledge Sharing Program

Tina M. Chindgren
Virginia Tech

The communities of practice model for knowledge sharing is examined in this conceptual paper. Key themes reflected in the literature – the linkage between knowledge and activity and the importance of relationships - are explored within the context of programs and practices within the National Aeronautics and Aerospace Agency (NASA) learning environment.

Keywords: Human capital, learning, professional development

In today's service-oriented, knowledge-intensive economy, human capital is a critical resource that can help organizations forge innovation. Consequently, if organizations are serious about increasing their knowledge assets to achieve enhanced innovation, they must first place primary emphasis on developing a solid human capital base (Chindgren, 2004). "The human capital in an organization primarily emanates from the "brainpower" of the organization's employees" (Liebowitz, 2004, p. 11). Knowledge management is the integrated, systematic approach to creating, capturing, codifying, applying, and sharing the brainpower – or knowledge – throughout the organization. This approach requires the participation of employees, customers, stakeholders, partners, and even vendors, contractors, and retirees.

Problem Statement

Frequently used activities for leveraging knowledge internal and external to an organization include creating an intranet, building a knowledge repository, implementing groupware to support collaboration, mapping sources of internal expertise, creating networks of knowledge workers, and establishing new knowledge roles such as the chief knowledge officer (Ruggles, 1998). As illustrated by these activities and in the literature, knowledge sharing approaches are dominated by cognitive theories that reflect a machine model or Newtonian clockwork perspective. A consistent theme in knowledge management entails capturing and sharing codified knowledge and reusable work products, often through information technology. As Cross, Parker, Prusak, and Borgatti (2001) remarked, activities such as "knowledge repositories" hold pragmatic benefits as they bridge boundaries of time and space and "allow for potential reuse of tools or work products employed successfully in other areas of the organization" (p. 101). They also provide a means of preserving organizational memory when employee turnover occurs.

Such initiatives, however, often undervalue crucial knowledge held by employees and the groups and communities that help create new knowledge and dynamically solve problems (Cross, et al., 2001). Increasingly, a key issue for knowledge management is fostering human interaction that enables the exchange of knowledge which contributes to organizational innovation. Observing, listening, practicing, questioning, debating, and collaborating have all become part of a prosperous knowledge sharing environment. In this knowledge-based, global economy, Chalofsky (1996) articulated the need for learning based on team and collective performance, as well as cooperation and collaboration. He also believed that employees should be encouraged to learn based on the discovery of possibilities, not based on one right answer. He recognized the value of learning based on intuition, relationships, and context. Preskill and Torres (1999, p. 14) elaborated that, with this shift, "learning is intentional and contextual, and it involves developing systems and structures that not only allow but also encourage organization members to learn and grow together – to develop "communities of practice."

The purpose of this paper is to examine knowledge sharing and learning activities at a U.S. Federal government agency using the community of practice model as a theoretical framework. To this end, I will review central ideas from Lave and Wenger's seminal work, *Situated Learning: Legitimate Peripheral Participation* (1991), in which the term "communities of practice" was purportedly coined. Communities of practice will then be contrasted with "learning communities," a frequently used mechanism with adult learners in the informal learning tradition. Finally, two key themes reflected in the community of practice literature – the link between knowledge and activity and the importance of relationships – will be applied to the agency's activities.

Theoretical Framework

Community of Practice Model Defined

Lave and Wenger (1991) used the term "community of practice" in their book *Situated Learning: Legitimate Peripheral Participation* to describe an informal, continuous, and naturally occurring learning process that was typical of traditional apprenticeships. In particular, it was Lave who observed that craft apprenticeships among Vai and Gola tailors in Liberia did not entail formally taught tailoring tasks. Instead, a novice tailor begins by doing "peripheral" and simple activities such as sewing buttons or hemming cuffs. Over time, the tailor takes on more responsibilities, and through shared activities within a community, the tailor develops master tailor skills.

Using observations of different apprenticeships (e.g., Ycatec midwives, US Navy quartermasters, meatcutters), Lave and Wenger (1991) illustrated that the nature of the situation impacts the learning process. They place learning squarely in the processes of "coparticipation," not in the cognitive processes of any *single* individual. Rather than focus on learning as the acquisition or discovery of knowledge, they situate learning in certain forms of social coparticipation and examine the types of social engagements that provide the proper context for learning. A community of practice is therefore described as "a set of relations among persons, activity, and the world, over time and in relation with other tangible and overlapping communities of practice" (Lave & Wenger, 1991, p. 98).

Lave and Wenger (1991) explained the importance of dynamic relationships with the term "legitimate peripheral participation." This is:

> An interactive process in which the apprentice engages by simultaneously performing in several roles – status subordinate, learning practitioner, sole responsible agent in minor parts of the performance, aspiring expert, and so forth – each implying a different sort of responsibility, a different set of role relations, and a different interactive involvement (p. 23).

It concerns the process by which newcomers or junior-level associates move toward full participation in the sociocultural practices of the community. Actual role responsibilities would be unique to the organization and would vary depending on learning and conditions. As a result, legitimate peripheral participation is not a structure, but "a way of acting" (p. 24). Furthermore, legitimate peripheral participation means that learning is not only a condition for community membership; it is also an evolving relationship over the long-term. Eventually, a newcomer will become an old-timer.

Participation entails "talking within" and "talking about" a community. "Talking within" includes "exchanging information necessary to the progress of ongoing activities" and "talking about" entails stories and community lore (p. 109). According to Lave and Wenger (1991), "both forms of talk fulfil specific functions: engaging, focusing, and shifting attention, bringing about coordination etc., on the one hand; and supporting communical forms of memory and reflection, as well as signalling membership on the other" (p. 109).

William Hanks remarked in his introduction to their book:

> The individual is not gaining a discrete body of abstract knowledge which (s)he will then transport and reapply in later contexts. Instead (s)he acquires the skill to perform by actually engaging in the process, under the attenuated conditions of legitimate peripheral participation. This central concept denotes the particular mode of engagement of a learner who participates in the actual practice of an expert, but only to a limited degree and with limited responsibility for the ultimate product as a whole. There is no necessary implication that a learner acquires mental representations that remain fixed thereafter, nor that the "lesson" taught consists itself in a set of abstract representations (Lave & Wenger, 1991, p.14-15).

With this notion that learning occurs within an actionable context, Lave and Wenger (1991) challenged the popular notion of learning as a self-contained structure. They considered learning to be a "*feature* of practice which might be present in all sorts of activities, not just in clear cases of training and apprenticeship" (Lave & Wenger, 1991, p.18). There are countless opportunities in everyday life in which people coparticipate with others and learn from those interactions. Examples include religious congregations, students in a university, colleagues on a project team, and staff meetings. In fact, learning through participation in groups addressing "real life" matters has been explored by researchers and practitioners of informal learning, as they have examined learning communities.

Learning communities

When conceptualizing "communities of practice," Lave and Wenger (1991) were influenced by a variety of disciplines including anthropology, sociology, and artificial intelligence. It should be acknowledged that many in the field of adult learning and human resource development were already familiar with a similar concept of "learning community." This concept reflects theories of learners actively obtaining knowledge and meaning through experience and interaction from others. Group activities and collaboration, according to many adult learning theorists, are essential to exploring, testing, and experimenting (Byham, 2000; Caudron, 2000; Marsick & Volpe, 1999; Marsick & Watkins, 1996; Pace, 2000).

Researchers have added elements to distinguish "learning communities" from other types of groups. For example, Spear (1993, p. 11) believed that learning community members are connected not only by work tasks but also by "matters of heart as well as the mind." Preskill and Torres (1999, p. 15) wrote that learning communities "exist within organizations that ascribe to a philosophy of democratic accountability, a reconception of the role of the individual in organizations, and an acceptance that change starts at the individual level, with individuals taking responsibility for the collective outcomes of their own and the organization's practices." Palloff and Pratt (1999) examined learning communities in cyberspace and saw the web as a metaphor for learning, where learning is "a network of interactions between the instructor and the other participants [and] through which the process of knowledge acquisition is collaboratively created" (p. 6).

Learning communities and communities of practice share characteristics such as providing a forum for critical reflection, active involvement in learning, community building, creating shared objectives while satisfying individual needs, and encouraging integration of ideas. However, communities of practice entail more than "learning by doing" or gathering together to discuss shared interests. It entails situated learning that requires participants to be full participants, generating meaning, within a specific practice. The knowledge shared is context-driven and primarily relevant to the community of practice. With communities of practice, the purpose is to gradually develop the less-experienced members (i.e., apprentices), recognizing that each member is valued, but has different levels of abilities to contribute. In contrast, a learning community may form because every member needs development. Consequently, with many learning communities there is an expectation for equal, democratic participation from each member.

Research Question: Communities of Practice within an U.S. Government Agency

The knowledge sharing themes reflected in learning communities and communities of practice have increasingly grown in popularity among practitioners. Notably, the communities of practice approach (i.e., Lave and Wenger's apprenticeship model) has been used by organization development practitioners recommending organizational learning and knowledge management approaches to workplace learning. Even the U.S. government is considering learning strategies that can best develop their workforce. This move to knowledge management is largely because 53 percent of the Federal civil workforce is eligible to retire in the next five years (Liebowitz, 2004) and the U.S. government is now struggling to prepare their less experienced employees who are in the pipeline to move into positions being relinquished. Since many of the less experienced employees are not prepared to "step up" and satisfy many of the government needs, the communities of practice model fosters the development of these employees and leverages the "lessons learned" that the more experienced employees can share before leaving the workplace.

It is increasingly evident that researchers are interested in the theoretical underpinnings of the communities of practice construct, and practitioners are interested in organizational examples and the application of themes to the workplace (Chalofsky, 1996; Hackett, 2000). After Lave and Wenger's (1991) seminal publication, other researchers and practitioners diagnosed and discussed elements of communities of practice. A review of the literature yielded two key themes – the link between knowledge and activity and the importance of relationships. Through the use of case study research, I examine these themes within a Federal government agency, the National Aeronautics and Aerospace Agency (NASA), as it addresses knowledge sharing and learning efforts. NASA was selected to study because of the agency's tradition of innovation and their current efforts to maximize human capital, including fostering the development of communities of practice.

Traditional HRD Efforts at NASA

NASA was founded in 1958 and has consistently been identified as a leading edge producer of, and a significant contributor to scientific and technological feats in air and space. At this agency, there are approximately 60,000 employees and contractors in a variety of occupations, such as scientists, engineers, technicians, administrators, contract officers, educators, and outreach specialists (Chindgren, 2002). The personnel are generally stationed either at headquarters in Washington, D.C., or at one of the ten centers and field facilities across the United States.

Within NASA, the Academy of Program and Project Leadership (APPL) is responsible for developing program and project leaders and is currently focused on creating forums of participants who gather together, in person, to share knowledge and learn from each other. This emphasis is a relatively new approach for this agency and a brief overview of the evolution of the activities will be presented in order to establish a context for the current effort to foster communities of practice. This historical perspective reflects a growing awareness, even sophistication, of the dynamics of learning in the workplace, as well as the challenges confronting NASA.

Since 1988, the mission of the organizational predecessor to APPL has evolved to continually respond to the changing environment and direction of NASA. Early on, the focus was on program and project management

training that would provide foundational knowledge to future generations of NASA project managers. It was understood that training could not replace "two critical sources -- time and duration to gain professional experience in the real world of projects and an unstated but essential reliance on a previous generation of project talent who would naturally serve as mentors, coaches and expert guides" (APPL, 2004). At this time, NASA was still managing large, expensive, long duration programs like Apollo and the Shuttle, and as a result, numerous learning opportunities were present.

A new era of revitalization started in 1992 with projects that were smaller, faster, and cheaper (Boyle, 2002). In this era, the emphasis was on "doing more with less," greatly increasing the volume of project work and doing it in a way that emphasized safety, innovation, low cost, speed and quality. Such a demanding vision dramatically altered the nature of both project management and the way talent would be developed. NASA then began to rely on curriculum-driven programs and a major effort was undertaken to identify the core competencies required for program and project leader success at different stages of a career. The advent of competency-driven project management development was inaugurated and intended to link critical project competencies to NASA-sanctioned learning and education. During the mid 1990s, there was an increased emphasis on career development, curriculum certification, benchmarking and research, and job aids and tools. During these years, the groundwork would be laid for a significantly broader and different developmental organization than originally envisioned (APPL, 2004).

Tremendous changes were occurring within the NASA business environment. Many of the changes were driven by Federally mandated directives and programs such as the President's Management Agenda and the Human Capital Plan, as well as the increasing mode of operating as a business, competition to increase productivity, shrinking budgets, and new technologies. These strategic, administrative, social, and technical changes were largely the responsibility of the project management workforce. "In a short span of time the responsibility of project managers has shifted from a pure focus on mission (technical, business, safety and customer satisfaction) success to responsibility for business management, commercialization, new technology identification and development, customer satisfaction, strategy and much more" (APPL, 2004). In such an environment, the question confronting NASA is how do they safely, efficiently and effectively meet the challenges of their current project portfolio?

In response to this question, the mission of APPL evolved into providing development and support for the individuals who lead and the teams that carry out NASA's programs and projects. This is accomplished through research and services in career development activities and tools, performance enhancement to projects, and knowledge sharing communities of practice.

Findings

To enhance the capability of program and project leaders, APPL has created three business lines: Career development, performance enhancement, and knowledge sharing. Career development business area provides products and services around professional development competencies and training and development. Performance enhancement business line is the fastest growing business area of APPL bringing world-class experts and learning design directly to NASA's programs and project teams when they need it, where they need it and how they need it. The knowledge sharing business area is focused on building and supporting NASA communities of practice for the express purpose of promoting leadership development through mentoring and teaching, capturing and communicating knowledge and wisdom from the best program and project leaders, and enhancing open communication and dialogue.

APPL's Knowledge Sharing Program has three components: the Forum of Master Project Managers, Transfer Wisdom Workshops and *ASK* Magazine. *ASK* Magazine (Academy Sharing Knowledge) is both an on-line and hard copy magazine launched in December 2000. It publishes project management stories and provides a medium for more explicit knowledge in interviews, book reviews, and a column on best practices. Stories are gathered from the Master Forums and Wisdom Transfer Workshops. With their knowledge sharing efforts, APPL demonstrates two key themes in the communities of practice literature - the link between knowledge and activity and the importance of relationships.

Link between Knowledge and Activity

Practitioners generally agree that problem solving and learning from experience are part of everyday life (Argyris, 1991; Hoffman, 2003a). Many now believe that knowledge generated from the experience of people engaged in organizational tasks, not the information that is more theoretical, needs to be shared in order to benefit the organization (Matthews & Candy, 2000; Nonaka & Takeuchi, 1995). Brown and Duguid (1991) believed that "experience at work creates its own knowledge and as most work is a collective, cooperative venture, so most depositional knowledge is intriguingly collective – less held by individuals than shared by work groups."

A community of practice represents the process of creating, sharing and applying new knowledge that is social and dynamic. Nonaka and Takeuchi (1995) have described how, in a knowledge-creating organization,

the processes move from the personal to the social, building on tacit as well as explicit knowledge in what they term a "knowledge-creating spiral." Furthermore, the workplace is increasingly viewed as essentially boundaryless with knowledge passing across disciplinary and organizational boundaries. Technology has contributed to the knowledge-creating spiral amplifying through the organization's environment.

The community of practice model is based on the idea that one cannot separate knowledge from practice (Nonaka & Takeuchi, 1995). As a result, a community of practice shares knowledge in "living" ways rather than in the form of a database or documentation. Even if the information is captured in a manual, the knowledge is frequently highly contextual and can not fully be collected. Members of a community of practice come together to learn from each other, and although learning continues to occur in planned, deliberate programs, much of it occurs through the self-directed or group-based learning activities created by members themselves. Matthews and Candy (2000, p. 49) claimed that perhaps as much as 90 per cent of "learning actually occurs incidentally or adventitiously, including through exposure to the opinions and practices of others also working in the same context." Wilson, Desmond, and Roberts (1994) have contended that the community of practice model of knowledge sharing is especially helpful when members have tacit knowledge and through working together, recreate and reinterpret knowledge to other activities.

For NASA, fostering "coparticipation" entails gathering together individuals who perform similar tasks to share best practices in the form of storytelling. Storytelling is increasingly used throughout the agency to simplify complex ideas related to project leadership and inspire change. The Transfer Wisdom Workshop's focus is on program and project leaders stories about their work experiences. Since the inception of this activity in November 2001, participants have crafted stories from their work experiences and then discussed concrete examples of best practices and lessons learned (Lee, 2003). Participants may or may not recognize that a group activity results in knowledge sharing, but they leave the forum able to share what they have learned with others, perhaps in other communities of practice.

Relationships are Key

When NASA reduced its overall civil service workforce by 26 percent and reduced the Headquarters staff by 50 percent between fiscal year 1993 and fiscal year 2000, knowledge sharing between experienced project leaders and journeyman level project leaders was compromised. Organizational restructuring and reductions resulted in a 52 percent reduction in supervisory positions and a 15 percent reduction in Senior Executive Service, the Federal government's most senior management level. On an Agency-wide basis, the supervisor to employee ratio went from 1:6 to 1:10. These changes reduced the number of on-site mentors and experienced project managers, placing new demands on creating innovative and accelerated strategies to enhance learning and development.

The APPL leadership quickly recognized the need to foster relationships. As McDermott states (in Murphy, 1999, p. 17):

> Learning traditionally gets measured on the assumption that it is a possession of individuals that can be found inside their heads…[Rather] learning is in the relationships between people. Learning is in the conditions that bring people together and organize a point of contact that allows for particular pieces of information to take on a relevance; without the points of contact, without the system of relevancies, there is not learning, and there is little memory. Learning does not belong to individual persons, but to the various conversations of which they are a part.

In order to encourage these conversations, the APPL leadership leveraged two types of relationships. First, the APPL program representatives or "knowledge sharing champions" take the initiative to encourage participation and establish relationships. They visit centers, sell APPL through presentations, improve APPL visibility, seek participants, and confirm buy-in (Hoffman, 2003a). Furthermore, the knowledge sharing champions ask experienced project mangers to recommend less experienced project managers for the workshop. As coordinator of the programs, Lee (2003, p. 16) believes that this personal recommendation "goes along with our vision of knowledge sharing as a grassroots initiative." Instead of appearing as if the invitation was a headquarters driven request for attendance, a respected, seasoned project manager extends the invitation, and potential participants are more likely to attend.

Second, and more characteristic of communities of practice, APPL facilitates relationships among participants in the programs. APPL leadership believes the programs are an opportunity to learn, as well as network across the agency. An important "lessons learned" is the tremendous value of face-to-face contact. Technology can enable communication, but interpersonal relationships appear to contribute to learning within the NASA workplace (Hoffman, 2003b). Additionally, the people that APPL invites to the workshop are not necessarily project managers or even people on a project management career track; however, they are members of the project community (e.g., procurement, systems engineering, and human resources) who can contribute to knowledge sharing. These participants are also a part of other communities of practice and after they participate in this forum, can share their newly acquired or discovered knowledge with others.

The leadership at APPL believes that the knowledge sharing activities are successful, and although evidence for this is currently anecdotal, an effort is underway to measure the contribution of the activities to NASA's

mission accomplishment (Hoffman, 2003b). The Knowledge Sharing Program "lessons learned" sessions reassure the leadership that there is valuable knowledge at each NASA location (i.e., headquarters, centers, and field facilities). In addition, it has become apparent that each person, regardless of experience, contributes to the knowledge sharing process (Hoffman, 2003a). Contributions have been demonstrated in the Master Forums, Wisdom Transfer Workshops, and *ASK* Magazine.

Conclusions and Implications for HRD

Whether it was their intention or not, Lave and Wenger (1991) helped to give greater relevance to the value of informal, networked, and social communities. They contributed a deeper understanding of the nature of learning within communities of practice to the informal learning tradition. Their thinking has helped practitioners consider how to use groups, networks, and associations with which participants are apart. Their work fostered the valuing of social engagements that facilitate learning and the recognition that there are more than cognitive processes involved (Hanks, in Lave & Wenger, 1991, p. 14).

With an understanding that learning is social and comes largely from our experience participating in daily tasks, NASA has been able to deepen the process of participation in their learning programs and foster the development of their human capital. Given the APPL mission of developing program and project managers, the apprenticeship model, which develops the next generation of managers by bringing less experienced project leaders together with seasoned ones, is an appropriate approach for NASA.

In addition, since communities of practice in the workplace are both formally and informally constructed, participants may be involved in a number of them. In some communities of practice, participants may be core members, while in others, they may sit more on the periphery. Either way, relationships are strengthened over time as communities of practice develop around matters that are important to participants.

Furthermore, as participants gather to share explicit and tacit knowledge, they create a shared sense of identity for their community of practice. As demonstrated in NASA with the Knowledge Sharing Program, participants engaged in activities (e.g., storytelling) and generated and shared ideas, enthusiasm, and commitment. The program also resulted in new concepts and tools, as well as vocabulary and symbols that reflect the knowledge of the community. As an added benefit, the program helps to develop and maintain organizational memory. The APPL leadership believes that the significance of fostering communities of practice is enhanced organizational effectiveness (Hoffman, 2003a). In fact, Daniel Goldin, former NASA Administrator, has stated, "The Academy [(i.e., APPL)] is, quite simply, our source of innovation for managing our projects and programs. It is the way we develop the future leaders of NASA" (Dahle, 1999, p. 322).

Although NASA believes that the knowledge sharing activities are successful, other organizations may not recognize the value of communities of practice. Or, for those communities that are recognized, harm may occur if they are treated as components of an organization and "managed" as a resource. Indeed, communities of practice quite likely thrive best when left alone to grow on their own. Organizations may aid communities of practice by acknowledging and training key support roles such as facilitators and knowledge brokers, supporting attempts to cultivate a group if none exist, leading the nurturing of external communities with customers and suppliers, tapping the community for key projects, and leveraging the community's interests to drive organizational change (Hackett, 2000).

Knowledge management is about making human capital – the knowledge that comes from the organization's employees, customers, stakeholders, retirees, contractors, and partners - foster innovation, productivity, and effectiveness. One approach, the communities of practice model for knowledge sharing, was presented here. To this end, the central ideas from Lave and Wenger's seminal work, *Situated Learning: Legitimate Peripheral Participation* (1991), in which the term "communities of practice" was purportedly first used, were reviewed. Second, communities of practice were distinguished from a frequently used informal learning mechanism with adult learners, learning communities. Finally, to help illustrate contemporary communities of practice within the Federal government, two key themes in the literature – the link between knowledge and activity and the importance of relationships – were applied to NASA. As was discussed, NASA has a history of innovation in science and technology and has applied the same aspiration to meeting its challenges to develop effective program and project leaders. Today, the approach is designed to foster knowledge sharing within and across communities of practice.

References

Academy of Program and Project Leadership (APPL). (2004). The history of APPL, http://appl.nasa.gov/about/history/index.html. Accessed 6 April 2004.
Argyis, C. (1991). Teaching smart people how to learn. *Harvard Business Review, 3,* 99-109.
Argyris, C. (1992). *On organizational learning.* Cambridge, MA: Blackwell.

Astin, A. (1985). *Achieving educational excellence: A critical assessment of priorities and practices in higher education.* San Francisco: Jossey-Bass.

Brooks, J., & Brooks, M. (1993). *In search of understanding: The case for constructivist classrooms.* Alexandria, VA: Association for Supervision and Curriculum Development.

Brown, J.S. & Duguid, P. (1991). Organizational learning and communities of practice: Towards a unified view of working, learning and organization. *Organization Science, 2*(1), 40-57.

Boyle, J. (2002). *Working "faster, better, cheaper": A Federal research agency in transition.* Unpublished doctoral dissertation, Virginia Tech.

Byham, W. (2000). How to create a reservoir of ready-made leaders. *Training & Development, 3,* 29-32.

Caudron, S. (2000). Learners speak out. *Training & Development, 4,* 52-55.

Chalofsky, N. (1996). A new paradigm for learning in organizations. *Human Resource Development Quarterly, 7*(3), 287-293.

Chindgren, T. (2004). Knowledge management leadership: Exploring the role of the chief knowledge officer. In G. Roth (Ed.). *Proceedings for the 2004 Academy of Human Resource Development Annual Research Conference.*

Chindgren, T. (2002). Dialogue as a vehicle for understanding: A case study on workplace dialogue. In L. Ross (Ed.). *Proceedings for the 2002 Institute for Behavioral & Applied Management Conference.*

Cranton, P. (1994). Types of group learning. *New Directions for Adult and Continuing Education, 71,* 25-32.

Cross, R., Parker, A., Prusak, L., & Borgatti, S. (2001). Knowing what we know: Supporting knowledge creation and sharing in social networks. *Organizational Dynamics, 30,* 2, 100-120.

Dahle, C. (1999, November). NASA's Mr. Team. *Fast Company, 29,* 322.

Hackett, B. (2000). *Beyond knowledge management: New ways to work and learn.* New York: The Conference Board.

Hoffman, E. (2003, July 16). Knowledge Management at NASA Presentation at Virginia Tech, Falls Church, VA.

Hoffman, E. (2003, November 3). Personal conversation at National Aeronautics and Aerospace Agency (NASA). Washington, D.C.

Lave, D., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* New York, NY: Cambridge University Press.

Lee, D. (2003). Transfer wisdom workshops: Coming to a NASA center near you. *ASK Magazine, 12,* 15 -19.

Liebowitz, J. (2004). *Addressing the human capital crisis in the Federal government: A knowledge management perspective.* New York: Butterworth-Heinemann.

Marsick, V., & Volpe, M. (1999) Informal learning on the job. *Advances in Developing Human Resources, 3,* v-100.

Marsick, V., & Watkins, K. (1996). Adult educators and the challenge of the learning organization. *Adult Education, 7*(4), 18-20.

Matthews, J. & Candy, P. (1999). New dimensions in the dynamics of learning and knowledge. In D. Boud & J. Garrick (Eds.). *Understanding Learning at Work* (pp. 47-64).

Myers, C., & Jones, T. (1993). *Promoting active learning: Strategies for the college classroom.* San Francisco: Jossey-Bass.

Murphy, P. (Ed.). (1999). *Learners, learning, and assessment.* London: Paul Chapman.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company.* New York, NY: Oxford University Press.

Preskill, H., & Torres, H. (1999). *Evaluative inquiry for learning in organizations.* Sage: Thousand Oaks.

Pace, R. W. (2000). Thinking seriously about human resource development. *Advances in Developing Human Resources, 7,* 44-48.

Palloff, R., & Pratt, K. (1999). *Building learning communities in cyberspace: Effective strategies for online classroom.* San Francisco: Jossey-Bass Publishers.

Ruggles, R. (1998). The state of the notion: Knowledge management in practice. *California Management Review, 40*(3), 80-89.

Spear, S. (1993). *The emergence of learning communities: The systems thinker.* Cambridge, MA: Pegasus Communications.

Smith, M. K. (2003). Communities of practice. The Encyclopaedia of Informal Education, www.infed.org/biblio/communities_of_practice.htm. Accessed 5 April 2004.

Wagner, E. (2000). Communities of practice: The structure of knowledge stewarding. In C. Depres & D. Chauvel (Eds.). *The Present and the Promise of Knowledge Management (*pp. 205-224). Butterworth-Heinemann, Boston, MA.

Wilson, F., Desmond, J., & Roberts, H. (1994). Success and failure of MRPII implementation. *British Journal of Management, 5*(3), 221-240.