Systems Thinking and Information Literacy: Elements of a Knowledge Enabling Workplace Environment

Mary M. Somerville, Ph.D.
Assistant Dean
Information and Instructional Services
Robert E. Kennedy Library
California Polytechnic State University
San Luis Obispo, California USA
msomervi@calpoly.edu

Anita Mirijamdotter, Ph.D.
Head, Research Division
Social Informatics
Information Systems Sciences
Business Administration and Social Sciences
Luleå University of Technology
Luleå, Sweden
anita.mirijamdotter@ltu.se

Lydia Collins
Graduate Student
School of Library and Information Science
San José State University
San José, California USA
lckern@slis.sjsu.edu

"It is the circulation of knowledge - not book circulation counts! - that produces learning." [7]

Abstract

Dynamic technology-driven circumstances fortify academic librarians' reconsideration of their professional purposes, processes and relationships. In response, California Polytechnic State University librarians in San Luis Obispo, California use Soft Systems Methodology tools and information literacy principles and practices. These processes advance data - driven dialogue on design and development of enhanced information and knowledge management tools. This action research approach produces new conversations that heighten information exchange and knowledge flow among librarians and with faculty and student constituencies. Reflective physical and virtual knowledge flow now supports work-in-progress that focuses on co-creation of a technology-enabled 'learning commons' involving an expanded set of campus stakeholders. Library practitioners' increased confidence and capability predict productivity enhancement and continuous learning as they assume new roles as architects of digital information and knowledge learning spaces.

Introduction

Robust information and communication technologies (ICT) and abundant digital information resources drive academic library users' expectations and provide rich arenas for university librarians to think anew about their professional purposes, conventional processes, and traditional relationships. In response, since September 2003, amidst a paucity of ready solutions and an absence of dialogue strategies, librarians at California Polytechnic State University in San Luis Obispo (Cal Poly, SLO) have employed conversation-based systems thinking strategies, anchored in information literacy principles and practices, to activate knowledge enabling capacity in their workplace. In this paper, we present results from a two-year study of conventional library and information science professionals, who had traditionally only described information artifacts (through cataloging metadata for indexing inventory) and 'pointed to' information finding tools (through reference, research, and instruction services). Since 2003, they have learned to substantively engage in the process of converting data to information and knowledge within increasingly situated and contextualized frameworks. Now, through extended boundaries of influence and concern sustained by ongoing relationships with faculty and student beneficiaries, librarians manage, integrate, and transfer knowledge as architects of 'digital information and knowledge learning spaces' [27].

0-7695-2507-5/06/$20.00 (C) 2006 IEEE

Action research context and framework

Action research [2, 17] is particularly suitable for situations in which participants aim to simultaneously bring about change in the project situation while learning from the process of deriving the change. The emphasis on inquiry-based learning, as well as attention to participation and involvement, intrinsically and "simultaneously assists in practical problem-solving and expands scientific knowledge, as well as enhancing the competencies of the respective actors" [2, 22]. In this case, project participants intended to revisit fundamental notions about organizational purpose(s), concurrent with reinventing constituency relationships and workplace roles. Between September 2003 and August 2005, eight academic librarians responsible for reference assistance and instructional delivery participated in this project. Diminishing demand for their traditional services encouraged them to rethink and relearn. As previously discovered in a Swedish library organization [28], participants were both 'library centric' and 'reference desk centric' [40]. In response, we introduced participants to dialogue-enabled and data-driven processes grounded in systems thinking and information literacy.

The theoretical framework for our action research project draws from organizational knowledge creation theory [31, 32, 33, 34, 42], relational information literacy theory and practice [9, 10, 13], and systems thinking methodology [14, 15, 16, 18]. Therefore, our work blends Eastern and Western approaches to knowledge creation through making tacit information explicit and codifying it, while also enhancing tacit knowledge flow through better human interaction, to generate new ideas.

Rethinking was guided by the application of this interdisciplinary theoretical framework through the process of Soft Systems Methodology, SSM [14]. SSM offers a holistic systems thinking framework comprised of rich pictures, root definitions, and conceptual models. The methodology provides common language and shared tools for discussion and analysis of the complexities and interdependencies of situated issues [29, 38, 99]. These strategies and techniques facilitate participants' efforts to make tacit professional knowledge explicit. SSM processes also encourage knowledge creation and exchange, which coincided with the desired outcomes for this action research and organizational change project.

As illustrated below in Figure 1, SSM consists of four iterative phases - finding out, modeling, comparing, and taking action. These constitutive elements serve to reinform participants' perceptions of real world problem situations.

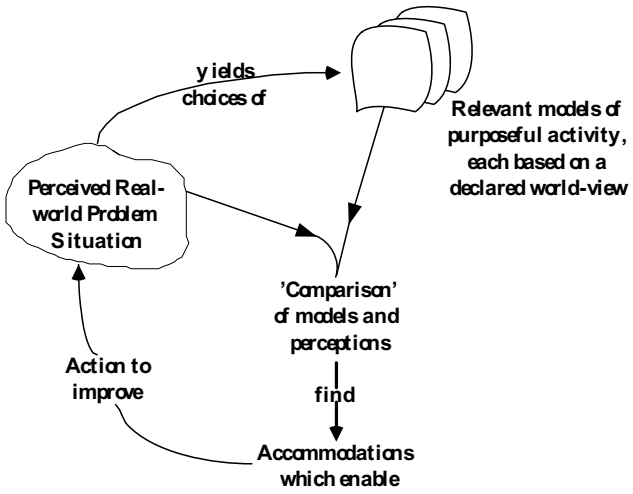

Figure 1. Soft Systems Methodology (SSM) Process

In the initial finding out phase, librarians explored various data sources and viewpoints. They investigated constituencies' information seeking and information utilization behaviors within the context of changing knowledge creation and dissemination patterns. In the modeling phase, participants characterized these trends through visual representations of purposeful activities, guided by SSM conventions. They also created visual renderings depicting their traditional professional work activities, in terms of purposes, functions, relationships, and interactions. When these figures were compared, participants discovered significant disparities between the realities and responses of librarians and their constituencies. Resulting insights catalyzed movement to the fourth stage, taking action.

The potential impact of this holistic methodology resides in its iterative nature, which encourages continuous data-driven inquiry-based dialogue. In this case the constitutive elements of SSM – finding out, modeling, comparing, and taking action – stimulated recognition of pivotal questions about contemporary users' needs. These inquiries required seeking and evaluating meaningful data, comparing and contrasting multiple interpretations, and infusing reflective insights – and unsolved curiosities – into a continuous learning process "that challenges existing ways of seeing and doing things, and can lead to some surprising shifts in Weltanschauungen, opening up novel and elegant proposals for…advancing thinking and taking action" [23]. Project participants 'learned their way to change' [20] as they recognized opportunities for better applying their traditional expertise.

To illustrate this organizational change process, through which librarians have 'retooled' and

'repurposed', we describe results of their learning process, including questioning 'bricks and mortar' boundaries and assumptions as evidenced in the progression of library-centric research guides into web based user-centered research portals.

Systemic rethinking and relearning

Soft Systems Methodology (SSM) guided information intensive learning processes that produced fresh insights and new proficiencies among librarians. Iterative data collection and analysis prompted improved awareness of stakeholders' realities even as it advanced librarians' knowledge creation and knowledge integration abilities. Gradually, as prior conceptions were incrementally activated and transformed, participants developed shared understanding and improved capacity for collective action [6]. Over the course of the two-year project, as librarians' thinking and learning prowess expanded, they discovered more fruitful roles and forged new synergistic relationships. Workplace culture increasingly valued research-in-practice, laying the foundation for a knowledge enabling learning environment.

Fortified by heightened information exchange and knowledge flow, librarians came to recognize the need to substantively transform their work purposes, processes, and relationships. Of particular relevance to the field of librarianship, the very nature of the SSM inquiry process encouraged participants to move beyond previously circumscribed boundaries that permitted 'getting to' but discouraged 'getting into' domain content. The incorporation of 'sense making' and 'meaning making' into librarians' professional repertoire was achieved by facilitating their production of information and knowledge from data.

The SSM taxonomy was particularly helpful when making discriminating distinctions between data, information, and knowledge during initial 'learn by doing' practice. The methodology offers the following conceptual definitions: 'data' (the factual invariance); 'capta' (data selected, created, or to which attention is paid); 'information' (meaningful selected data in a context); and 'knowledge' (larger, longer-living structures of information) [16, 36]. For professionals accustomed to making information organization and access decisions for authoritative refereed literature – but not actually working with the ideas embodied in those resources, SSM terminology guided classification activities that introduced both contextual and situated dimensions of user need and creator perspective.

Over time as project participants internalized this understanding, their work priorities reflected that, in the conversion of data to knowledge, data becomes more valuable at the point that it is transformed into information within a context. Librarians experienced this phenomenon early in the project when they used SSM to reflect upon the service usage statistics collected and reported annually. Traditionally content with merely fulfilling the California State University (CSU) System's reporting requirement, they had never before analyzed and interpreted the data. Through SSM-guided discussion, selected data proved especially informing – i.e., declining transaction numbers became capta. In furthering the foundational SSM 'finding out' phase, librarians compared Cal Poly numbers with the twenty-two other institutions in the CSU System. Modelling and comparing usage and resource patterns over time and across institutions provided an improved understanding of the organization's situated context, and, as well, advanced professionals' interpretive 'sense making' capabilities. Through ongoing application of conversation-based, data-driven holistic inquiry, 'shared meaning' evolved which produced consensus for library wide repurposing and reorganizing.

Throughout, the development of information literacy proficiencies has anchored our approach to workplace and work force knowledge production. When activated throughout the enterprise, this capacity ensures robust collective abilities to frame appropriate questions, select authoritative resources, and interpret and apply richly textured insights that can accelerate sound transformation decisions about work purposes, processes, and relationships.

From Organization Centric to Knowledge Centric

Practice with the dialogue-based SSM inquiry process has provided librarians with contextualizing tools for discovery and delivery. Following introduction to systems thinking philosophy and tools between September and December 2003, librarians initiated their investigatory process by making 'house calls' to academic departments between January and June 2004. Through dialogue with faculty, they developed an improved understanding of the curriculum priorities. This, in turn, fueled practice making tacit professional knowledge explicit through writing research guide content aligned with key learning outcomes for the academic disciplines.

As they worked on this content, librarians also cooperated with student researchers enrolled in senior level Human Computer Interaction (HCI) courses. Student teams collected data from their peers to develop conceptual prototypes for migrating this research guidance content to web accessible information products. Outcomes produced between March and December 2004 yielded an information visualization template for disciplinary research portals, subsequently evaluated by student-implemented usability tests [35]. Librarians' consultative engagement with student

researchers initiated fledgling working relationships with stakeholders that, over time, have produced heightened appreciation for user-centered perspectives and strong desire for ongoing two-way communication. Concurrently, making sense of student generated data deepened librarians' appreciation for the 'chasm' dividing their traditional professional worldview and that of their stakeholders, even as dialogue revealed 'bridge making' and 'shared meaning' possibilities.

In December 2004, in discussion with an interactive evaluator external to the organization, librarians reported that student findings clearly demonstrated that their initial research guides failed to meet undergraduate students' learning requirements. Guides were library-centric, reflective of the producers' realities but not consumers' viewpoints [21]. In response, librarians investigated relational information literacy as advanced in the second edition of the *Australian and New Zealand Information Literacy Framework: Principles, Standards, and Practices* [13]. The term 'relational' assumes that information literacy is necessarily demonstrated in a context and within a domain of content – a point of view that now informs librarians' collaborative co-design with faculty partners and student beneficiaries of virtual learning environment prototypes seamlessly integrated into course curricula and rich in digital information resources.

In accomplishing these ambitious outcomes, librarians – who had worked independently on initial research guide development - realized the potential value of learning from colleagues with other disciplinary specialties, as they had learned to do when exchanging information and insights to make sense of student-generated research data. This required learning to communicate with colleagues who share community of practice affiliation but lack conversance with such disciplinary differences as specialized terminology, research methodologies, and reporting conventions. Boland and Tenkasi [8] refer to the complex process of building a community knowledge base as 'perspective making' and 'perspective taking'.

This phase of professional transformation embodies the notion of *Ba* [32] as a shared space for emerging collegial relationships. This space may be physical such as a designated meeting room, virtual such as e-mail exchanges or videoconference sessions, or mental such as shared experiences or ideas, or any combination of them. It is from here that a transcendental perspective can emerge which integrates information into knowledge, within a context that harbors meaning. As the Cal Poly project suggests, knowledge embedded in such shared spaces can be acquired and integrated by individuals into reflective professional research-in-practice.

What are the implications of the *Ba* concept for knowledge creation? Librarians responded to this question in a June 2005 videoconference session facilitated by the same external evaluator as in December 2004. The evaluator used this session to encourage participants to reflect on elements and processes in a knowledge enabling workplace. Following co-construction of evaluative criteria for progress indicators, including socio-technical elements, participants spoke about their work in knowledge creating teams. Creation of deliverables with recognized public value, they said, emerges from 'multiperspectival' insight developed in shared physical places and virtual spaces – *Ba* – for team and/or organizational communication. They cited student critique of their web based information products as informing both their understanding of information architecture and instructional design, as well as student learning preferences and research needs.

In assessing their team learning, project participants enthusiastically described their improved abilities to make tacit information explicit for exchange and transfer among project members. They acknowledged the enablement resulting from their attention to information literacy attributes which, though the core competence of the field's practitioners, is typically not explicitly leveraged in everyday practice. They also attributed extension of their professional boundaries of concern and influence to systems thinking, as advanced by Soft Systems Methodology and evidenced through increasingly pro-active collaboration with appropriate campus stakeholders. In addition, Cal Poly librarians expressed an understanding that knowledge creation requires context or knowledge space, saying – in their own words - that *Ba* is an arena for creating, collecting and integrating the organization's applied knowledge in a spiraling process of interactions between explicit and tacit knowledge. These interactions, they recognized, lead to the creation of new knowledge. Through persistent knowledge flow, they said, they prepare to transition successfully to new digital architect and knowledge integration roles.

Toward a knowledge enabling organizational environment

During 2004, librarians applied their rudimentary understanding of academic curriculum to produce one-dimensional web research guides – 'data dumps' intended to increase their proficiency with making tacit professional knowledge explicit. Then, to establish the 'shared meaning' necessary to information exchange within a community of practice, they initiated reflective dialogue informed by systems thinking and information fluency. These learning activities prepared them in early

2005, appreciably enabled by student-generated assessment results, to initiate the content redesign process for web accessible access.

In planning the next product release, librarians drew upon a rich array of insights. Mindful that users wanted to 'find' – i.e., that they were not as enthralled as librarians by the 'search', they considered website design choices, made information architecture decisions, and drafted curriculum integration proposals. These activities occurred within a workplace learning environment enabled by explicit information exchange and knowledge creation among librarians who increasingly involve faculty colleagues and student beneficiaries as well.

Between January and June 2005, an externally funded data collection project involving three academic institutions in two countries (USA and Sweden) yielded rich student-generated data on user-centered learning spaces, which will take librarians' digital knowledge integration responsibilities to the next level. Evolving out of the information commons movement of the last decade [1, 3, 4, 5], the learning commons project in the library represents an evolving collaborative partnership with both Information Technology Services (ITS) and the Center for Teaching and Learning (CTL). Soft Systems Methodology will guide the initiating dialogue, creating meaning, forming intentions, and taking actions that inform the socio-technical design and development of student-centered virtual learning spaces and physical learning places. The planning process for populating this physical and virtual 'innovation zone' for teaching and learning anticipates ongoing interactive evaluation [30] from the founding faculty and student beneficiaries. Building on the librarians' organizational development focus during the past two years, the innovative Cal Poly learning commons' mission aims to enable boundary-crossing knowledge production.

In imagining how this might be accomplished in physical places and virtual spaces, librarians draw from their systems thinking and information literacy practice since 2003. Encouraged by their learning accomplishments, they now infuse these tenets into planning discussions with CTL and ITS colleagues who recognize that, to advance knowledge creation and knowledge flow among learning commons' participants, they must also achieve this within the implementation team. The project thereby serves as a 'learning object' [20] for both its builders and its beneficiaries. Toward that end, in alignment with the initiative's knowledge creation mission, planning participants explicitly cultivate their collective inquiry capabilities. In their deliberations, they consistently strive to engage with authoritative information resources, employ information literacy principles, and incorporate active learning pedagogies that foster successful user – and builder – knowledge creation experiences.

This research and development (R&D) collaboration offers librarians rich opportunities to apply what they learned in inventing web based digital research portals. Similarly, the learning commons depends on valuing diverse stakeholders' situated contexts through building relationships conducive to asking the right questions to produce authentic data that yields interpretations that, interactively, produce two-way empathy and insight - an approach that has been adopted increasingly across the library organization [29, 40, 31]. Therefore, librarians are poised to demonstrate the value of their core disciplinary knowledge – as reflected in information literacy proficiencies. It has both enriched their own work life and is imminently transferable to this new collaboration arena.

Librarians' heightened abilities to express their tacit knowledge, in combination with increased proficiency in exchanging information and engaging in disciplinary and interdisciplinary knowledge creation, has repositioned the library organization and personnel on campus. Librarians – renamed 'knowledge managers' – anticipate working with faculty partners to populate the learning commons with curriculum integrated, resource-rich projects, customized to recognize disciplinary differences and continuously improved through interactive evaluation. They now lead faculty colleagues in applying core information literacy elements and systems thinking practices to Commons' development strategies. Their professional portfolios now include proficiencies in problem identification, information seeking, resource evaluation, information organization, sense making, meaning making, knowledge creation, knowledge dissemination, and knowledge integration. Significantly, the very constructs that have driven interactive reinvention of the library organization now support planning for boundary crossing knowledge creation and exchange in the campus commons within an every increasing number of stakeholders across a wide variety of disciplines.

Knowledge enabling, exchange, and transfer reflections

At Cal Poly, research-in-practice is increasingly embedded in the library workplace culture. Information fluency and systems thinking frameworks, principles, and practices guide individual and group learning through 'learn by doing' practice applying co-design principles and practices. Throughout, discussions are enriched by explicit recognition of enterprise-level mission and vision priorities, as further textured and customized by disciplinary drivers. Systems thinking is enriched by dialogue about information seeking, evaluating, organizing, and reporting as contextualizing elements for framing good questions, identifying

authoritative information, comparing plausible interpretations, and weighing possible communication strategies. These proficiencies may constitute, we believe, academic librarians' distinctive contributions to the knowledge creation, organization, and dissemination activities underpinning teaching, learning, and researching. The library's knowledge managers now demonstrate their new capabilities as they co-create inviting virtual learning environments enriched through making tacit relationships among ideas contained in information and knowledge artefacts explicit. Through igniting their own knowledge transfer, sharing, and exchange processes, they are readied to facilitate new levels of knowledge enabling, exchange, and transfer with and among other teaching and learning stakeholders. Convinced of the value of action research that blends systems thinking with information literacy, they now infuse this approach into planning and implementation activities for populating technology-enabled and information-rich physical and virtual learning environments intended to advance discourse across disciplinary learning communities.

Outcomes-to-date suggest productivity enhancement through heightening individual and team information literacy proficiencies, within the context of holistic and systemic views of realities. As documented in a small but important literature, this focus anticipates growing recognition that information literacy capabilities are becoming increasingly critical to organizational success as well as professional practice [11, 19, 24, 25] when, in a relational fashion, information competence advances concurrent with professional knowledge. Our results complement the already extensive literature on the value of systems thinking and, particularly, attention to the soft human elements. Our research framework also anticipates growing recognition about the usefulness of sustained consultative relationships between builders and beneficiaries of information and knowledge management tools and resources in increasingly digital learning environments.

While the learning organization literature provides ample explanation for the importance of systemic thinking in workplace learning culture, we are unaware of other researchers who purposefully combine systems thinking with information literacy for the purpose of knowledge creation. Therefore, we urge further research on what we believe to be a promising interdisciplinary hybrid approach. We are especially interested in hearing from researchers who apply systems thinking and interactive evaluation to animate and inform conversations about information and communication technology (ICT) among active learning environment builders and beneficiaries.

We are also very interested in learning more about possible cultural differences that could obviate the 'remarkable' effect of introducing systems thinking to individuals possessing strong individualist Western values. For instance, we imagine that members of ethnocultural communities with collective and holistic orientations will possess the information exchange and knowledge sharing attitudes and behaviors requisite to synergistic knowledge creation proficiency development. We wonder how (and if) these intrinsic qualities are leveraged within such communities to enable group learning and advancement through knowledge making. We also believe that while more linear, rational cultures might be more likely to value explicit inquiry – though not necessarily cherish the interpretive approach advanced here, we have much to learn from non-Western societies which intrinsically value holism, dialogue, and reflection. We therefore very much welcome communication about diverse approaches for advancing knowledge creation, transfer, and flow in a variety of appreciative settings.

References

[1] Bailey, R. & Tierney, B. (2002). Information commons redux: Concept, evolution, and transcending the tragedy of the commons, *The Journal of Academic Librarianship* 28 (5): 277-286.

[2] Baskerville, R. L. & Wood-Harper, A. T. (1996). A critical perspective on action research as a method for information systems research, *Journal of Information Technology*, 11, 235-246.

[3] Beagle, B. (1999). Conceptualizing an information commons, *Journal of Academic Librarianship* 25 (2): 82-89.

[4] Beagle, D. (2002). Extending the information commons: From instructional testbed to Internet2, *Journal of Academic Librarianship* 28 (5, 2002): 287-296.

[5] Beagle, D. (2004). From information commons to learning commons, August. Available: http://www.usc.edu/isd/libraries/locations/leavey/news/conference/presentations/presentations_9-16/Beagle_Information_Commons_to_Learning.pdf

[6] Bennett, D. H. (2004). Learning and the knowledge worker. In *Knowledge Management Lessons Learned – What Works and What Doesn't*, edited by M. E. D. Koenig and T. K. Srikantaiah, pp. 511-525. Medford, New Jersey: Information Today, Inc.

[7] Bennett, S. in Bennett, S., Demas, S., & Freeman, G. T. (2005). *Library as Place: Rethinking Roles, Rethinking Space*. Washington, D.C.: Council on Library and Information Resources. Available: http://www.clir.org/pubs/abstract/pub129abst.html

[8] Boland, R, and Tenkasi, R. (1995). Perspective making and perspective taking in communities of knowing. *Organization Science* 6 (4):350-372

[9] Bruce, C. (1997a). *Seven faces of information literacy in higher education.* http://sky.fit.qut.edu.au/~bruce/inflit/faces/faces1.php

[10] Bruce, C. (1997b). *The Seven Faces of Information Literacy*. Adelaide, Australia: Auslib Press.

[11] Bruce, C. (1999). Workplace experiences of information literacy. *International Journal of Information Management*, 19, 33-47.

[12] Bruce, C. (2002, July). *Information literacy as a catalyst for educational change: A background paper.* White Paper prepared for UNESCO, the U.S. National Commission on Libraries and Information Science, and the National Forum on Information Literacy, for use at the Information Literacy Meeting of Experts, Prague, The Czech Republic. http://www.nclis.gov/libinter/infolitconf&meet/papers/bruce-fullpaper.pdf

[13] Bundy, A. (Ed.). (2004). *Australian and New Zealand Information Literacy Framework: Principles, Standards, and Practice.* 2nd ed. Australian and New Zealand Institute for Information Literacy and Council of Australian University Librarians. Available: http://www.caul.edu.au/info-literacy/InfoLiteracyFramework.pdf

[14] Checkland, P. B. (1999). *Systems Thinking, Systems Practice: Includes a 30-year Retrospective*. Chichester, England: John Wiley & Sons.

[15] Checkland, P. B. (2000). Soft Systems Methodology: A thirty retrospective. *Systems Research and Behavioral Science,* 17 (S1), S11-S58.

[16] Checkland, P., & Holwell, S. (1998a). *Information, Systems and Information Systems - Making Sense of the Field*. Chichester: John Wiley and Sons.

[17] Checkland, P., & Holwell, S. (1998b). Action research: Its nature and validity. *Systemic Practice and Action Research*, 11, 9 – 21.

[18] Checkland, P., and Scholes, J. (1990). *Soft Systems Methodology in Action*. Chichester: John Wiley & Sons.

[19] Cheuk, B. (1998). An experienced based information literacy model in the workplace: Case studies from Singapore. In D. Booker (Ed.), *Information Literacy: The Professional Issue. Proceedings of the 3rd Australian National Information Literacy Conference* (pp. 74-82). Adelaide: University of South Australia Library.

[20] Davis, H. L. & Somerville, M. M. (2005). *Learning our way to change: Toward improved institutional alignment*. (unpublished paper).

[21] Gillette, D., & Somerville, M. M. (2005). Faculty and student usability and focus group findings inform Digital Teaching Library interface requirements. In *Proceedings of the Syllabus Higher Education Technology Conference*, July 24-28, Los Angeles, CA. http://download.101com.com/syllabus/conf/summer2005/PDFs/Th05_b.pdf

[22] Hult, M. & Lennung, S. A. (1980). Toward a definition of action research: A note and bibliography. *Journal of Management Studies*, 17, 241-250, in Baskerville, R. L. & Wood-Harper, A. T. (1966)

[23] Jackson, M. (2003). *Systems Thinking – Creative Holism for Managers*. Chichester, England: John Wiley and Sons.

[24] Kuhlthau, C. C. (1999). The role of experience in the information search process of an early career information worker: Perceptions of uncertainty, complexity, construction, and sources. *Journal of the American Society for Information Science*, 50 (5), 399-412.

[25] Kuhlthau, C. C., & Tama, S. L. (2001). Information search process of lawyers: A call for 'just for me' information services. *Journal of Documentation*, 57 (1), 25-43.

[27] Materska K. (2004). Librarians in the knowledge age. *New Library World* 105: 142-148.

[28] Mirijamdotter, A. and Somerville, M. (2003). Toward creative systemic thinking processes: An information competency based transformation model for organizational leadership. Paper presented in Mörtberg, C. et al. *Information Technology, Transnational Democracy and Gender – Reloaded (ITDG)*, Luleå, Sweden, p. 23 (abstract). http://www.luth.se/depts/arb/genus_tekn/ITDGconferencelulea.htm

[29] Mirijamdotter, A., & Somerville, M. M. (2005). Dynamic action inquiry: A systems approach for knowledge based organizational learning. In *Proceedings of the 11th International Conference on Human-Computer Interaction*, Las Vegas, Nevada, July 22-27. (CD-ROM).

[30] Mirijamdotter, A., Somerville, M. M., & Holst, M. (2005). An interactive evaluation approach for the creation of collaborative learning commons. In *Twelfth European Conference on Information Technology Evaluation (ECITE 2005)*, Turku, Finland, September 29-30. (forthcoming).

[31] Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science* 5 (1): 14-37.

[32] Nonaka, I. & Konno, N. (1998). The concept of 'ba': Building a foundation for knowledge creation. *California Management Review* 40(3): 40-54.

[33] Nonaka, I., Konno, N., and Toyama, R. (2000). SECI, Ba and leadership: A unified model of dynamic knowledge creation. *Long Range Planning* 33:5-34

[34] Nonaka, I, and Toyama, R. (2003). The knowledge-creating theory revisited: Knowledge creation as a synthesizing process. *Knowledge Management Research & Practice* 1:2-10.

[35]Rogers, E., Somerville, M. M., & Randles, A. (2005). A user-centered content architecture for an academic digital research portal. In *Proceedings of the ED-MEDIA - World Conference on Educational Multimedia, Hypermedia & Telecommunications*, Montreal, Canada, June 27-July 2. (CD-ROM)

[36] Rose, J. (2002). Interaction, transformation and information systems development - An extended application of Soft Systems Methodology. *Information Technology and People* 15 (3):242-268

[37] Somerville, M. M., Huston, M. E., & Mirijamdotter, A. Building on what we know: Staff development in the digital age. *The Electronic Library* 23 (4, 2005): 480-491.

[38] Somerville, M. M., & Mirijamdotter, A. (2005). Working smarter: An applied model for "better thinking" in dynamic information organizations. In *Currents and Convergence - Navigating the Rivers of Change: Proceedings of the 12th National Conference of the Association for College and Research Libraries (ACRL)*, April 6-10. Minneapolis, Minnesota. Chicago, Illinois: American Library Association. pp. 103-111.

[39] Somerville, M. M., & Mirijamdotter, A. (2005). Soft Systems Methodology results transform professional roles in the digital teaching library. In *Proceedings of Syllabus Higher Education Technology Conference*, July 24-28, Los Angeles, CA.
http://download.101com.com/syllabus/conf/summer2005/PDFs/Th05_b.pdf

[40] Somerville, M. M., & Schader, B. (2005, July). Life after the reference desk: Co-creating a digital age library. *The Charleston Advisor* 7 (1): 56-57.

[41] Somerville, M. M., Schader, B., & Huston, M. E. (2005). *Rethinking what we do and how we do it: Systems thinking strategies for library leadership*. (unpublished paper).

[42] Von Krogh, G., Ichijo, K., & Nonaka, I. (2000). *Enabling Knowledge Creation. How to Unlock the Mystery of Tacit Knowledge and Release the Power of Innovation*. New York, NY: Oxford University Press.

[43] Weick, K. E. (1995). *Sensemaking in Organizations*. Thousand Oaks, CA.