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**Toward Co-Creation of Knowledge in the Interaction Age: An
Organizational Case Study**

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Abstract: Converging information, communication, and computing technologies create new opportunities for university librarians to contribute to knowledge creation activities. At California Polytechnic State University in San Luis Obispo, USA, authors partner with academic colleagues to develop student learning experiences which reflect the dynamic engagement with information that characterizes the Interaction Age.

Introduction

The first years of the new millennium have seen dramatic changes in how information is produced, as well as how it is accessed, organized, and communicated. As a consequence, as new technology tools enable effortless information consumption and peer knowledge production, the traditional role of libraries – acquiring and organizing sources and enabling access – is increasingly called into question. These circumstances challenge libraries' traditional roles, forcing librarians to reconsider their professional purposes, responsibilities, and relationships.

In addition, as technologies have transformed how we encounter and experience information, even the common held conception of information has changed. In today's Interaction Age, information is seen as something with which, and around which, people can interact. For instance, content is no longer just prepackaged and delivered in an unchangeable digital form. Rather, it is posted for group editing. The Interaction Age is a logical extension of the Information Age; it extends familiar information technologies – and emerging new ones – to emphasize interactivity over mere content delivery (Milne 2007).

Within this framework, the authors developed a collaborative co-design approach which involves students in a range of learning activities that improve electronic search tools, enhance library website functionalities, and enable 'knowledge making' virtual reality projects. The methodology for these projects - completed during a 3-year period from 2003 to 2006 –involved students in working interactively with academic librarians and other campus stakeholders to co-create digital learning objects, digital learning activities, and digital learning environments (Somerville & Brar 2006).

Highly participatory in nature, the co-design processes benefited from the knowledge of students who have grown up with the digital technologies developed in the last decades of the 20th century and now widely available in the new millennium. These students have spent their entire lives using computers,

video games, digital music players, video cameras, mobile phones, email, instant messaging, and other technology tools and toys. As a result, these 'digital natives' think and act differently than the people for whom today's libraries were designed (Lippincott 2005, Windham 2005, Windham 2006, Prensky 2001, Prensky 2001). Therefore, library services and systems must change (Lukasiewicz 2008).

In addition, this approach benefited from the participatory action research orientation of the social informatics consultant who designed and delivered this approach at the Luleå University of Technology (Ltu) in Sweden. Subsequently, Dr. Anita Mirijamdotter introduced participatory co-design principles at California Polytechnic State University (Cal Poly). The campus' distinguishing 'learn by doing' educational philosophy shaped its unique expression of guiding co-design principles. Now this approach has been introduced at the Dr. Martin Luther King, Jr. Library – an award winning joint university-public library in San José, California (Somerville & Nino 2007). Progress to date suggests that the institution's location in California's Silicon Valley will produce yet another distinctive set of implementation practices and products.

The examples which follow, therefore, are meant to be illustrative. They demonstrate the potential of re-inventing librarians' interactions with information and knowledge and with students and faculty. In addition, these experiences suggest the fundamental changes which occurred in how participating librarians thought and what they thought (Somerville & Mirijamdotter 2005; Somerville, Rogers, Mirijamdotter, & Partridge 2007; Somerville, Schader, & Huston 2005; Somerville, Huston, & Mirijamdotter 2005). Here we focus on identifying new opportunities for librarians' involvement in student learning and faculty teaching.

Participatory Design Fundamentals

With deep roots in Scandinavian participatory design philosophy and practice, this 'research-in-practice' approach applies student insights to identify new Interaction Age opportunities for libraries and librarians. There are two

varieties of interaction: human-to-information and human-to-human. As the following project outcomes illustrate, the libraries' digital research and development (R&D) efforts aimed to promote and support both types of interaction. This involved inviting student framed, student conducted, and student interpreted research findings. Employing a range of methodologies – e.g., focus groups, usability studies, rapid prototyping, and survey instruments, student selected topics or issues of concern. Then, supervised by faculty, they selected appropriate research methods, generated and interpreted data, and produced recommendations for librarians, which produced real world benefits. At the same time, these inclusive R&D processes built the sustainable relationships necessary for library staff to understand user expectations and preferences now and in the future.

The undergraduate students first involved in the librarians' new discovery process were third year computer science students at California Polytechnic State University (Cal Poly) in San Luis Obispo. The campus is one of twenty-three institutions in the California State University (CSU) system. With over 300,000 students, it is the largest publicly funded higher education system in the world. Cal Poly is one of the larger campuses, with 18,000 students – including nearly 10,000 undergraduate students enrolled in the basic and applied sciences and engineering. The university's distinctive 'learn by doing' educational philosophy guided the co-design project – i.e., both librarians and students felt comfortable learning by doing.

In 2004, human-computer interaction (HCI) students were invited to evaluate an 'out of the box' federated search engine (ExLibris MetaLib) for searching multiple databases and accessing full text documents. They selected a variety of user-centered design approaches to seek input from their peers. For instance, they developed, tested, and implemented a questionnaire that focused on student research habits, student research skills, and student learning styles. In addition, they conducted usability studies on the current interface. These

insights were supplemented by focus groups and peer-to-peer interviews. In addition, student research teams were – throughout - as representative as possible of the university's student population.

At the conclusion of their research on the federated search engine interface, students produced a report for librarians' consideration. Student researchers unanimously recommended that:

- The 'meta' search engine should mirror the 'look and feel' of Google's search functionalities,
- A 'my e-shelf' should permit citations to be organized by course and indicate availability, including full-text status,
- A 'my databases' should permit saving lists by course and allow federated database metasearching, and
- A 'my e-journal' list should capture search history, provide an alert profile, and allow direct linkage to a customizable 'my PolyCAT' (university online catalog) personal information organization space.

Comparison of student recommendations and the vendor's interface revealed a serious 'gap.' In response, Cal Poly librarians worked with library programmers to integrate students' suggestions into a customized interface for Cal Poly information seekers. Students' findings were also sent to the vendor's R&D team, who chose to integrate many of the students' recommendations into the next release of the commercial product. In addition, students' recommendations informed R & D efforts at the California State University Chancellor's Office, where staff members customize 'out of the box solutions' for possible implementation at the system's 23 campuses.

From this initial co-design experience, Cal Poly librarians learned to examine the underlying assumptions and beliefs that traditionally guided their decision making processes for system interface designs. They recognized that achievement of user centric thinking requires rethinking traditional assumptions

about what to study, as well as how – and with whom - to conduct research. And they gained insight into the knowledge creation potential of working in new ways with beneficiaries – in this case, students and faculty – to repurpose, retool, and reprioritize.

User-Generated Enhancements

As the preceding discussion illustrates, a user-centric approach to co-creating effective user interfaces - the means by which end users communicate with technology - requires careful consideration of the context for usage. For example, interaction designers must consider:

- How do people work?
- How do people solve problems?
- How will technology enabled 'solutions' be incorporated into work practices?
- How do people interpret the technology enabled systems' output?
- What are user communities' information and technology usage strengths and weaknesses?

Recognition of the importance of these considerations informed librarians' desire to deepen their investigatory relationships with students. Subsequent research projects, therefore, posed more ambitious questions and sought more sustainable communication relationships. For instance, in the Cal Poly Learning Commons initiative (<http://learningcommons.lib.calpoly.edu/>), students explored how their peers interact with and relate to information.

The initiative originated within the Offices of the President and the Provost. Funding required that the faculty professional development center (CTL), the university library (LIB), and the campus information technology services (ITS) create integrated services and systems to support faculty teaching – and student learning - innovations. The student-centered campus culture quite naturally involved many undergraduate students - and interested teaching faculty - in design activities. For instance, students on the campus computing committee

advised the learning commons partners (CTL-ITS-LIB) on the evolving commons concept throughout the planning year. Concurrently, the emerging concept was approved by senior academic administrators, the academic senate technology committee, the council of deans, and other campus governance and advisory bodies. Throughout, rich campus wide input informed the design concept to:

- Provide technological infrastructure, pedagogy and technology expertise, and information resources and consultation to enable faculty innovation and curriculum revitalization and
- Encourage application of constructivist principles to advance students' information, communication, and technology proficiencies for life long learning.

After the learning commons opened, students were invited to conduct project-based investigations to further 'next phase' developments. Supervised by campus faculty, students generated research questions, selected research methodologies, and interpreted research data. Results revealed students' recommendations for extending the purpose of the commons to:

- Promote cross-disciplinary inquiry and discourse and
- Create an inclusive, interactive learning community.

In presenting their ideas to learning commons planners, students emphasized that peer production practices for inclusive social information exchange and knowledge creation required that learning commons service providers should also include writing center experts, study skills specialists, and software training consultants. This advice served to enlarge the 'service circle' originally envisioned by the CTL-ITS-LIB planners.

Students also recommended other enhancements found elsewhere in information and learning commons around the world as well (Somerville & Harlan 2007). For example, students in software engineering and artificial intelligence courses used 3D-modeling techniques to design a variety of learning spaces - virtual collaboration rooms, a senior project marketplace, a multimedia café, and

a campus knowledge repository. They also implemented usability studies, focus groups, and online surveys. These new student generated ideas stimulated planners' interest in continuing co-design activities, as they reconsidered design assumptions.

A significant difference in planner perspectives and student viewpoints involved the matter of formal and informal learning spaces. While the CTL-LIB-ITS planners had focused primarily on advancing students' formal learning activities, students recommended blending formal and informal learning experiences. Their multimedia café proposal, for instance, included ready access to food and drink as well as relaxing/leisure opportunities. Students' 'best practice' recommendations were derived from industry standards set by Starbucks coffee houses and Borders/Barnes and Noble bookstores – further challenging planning notions.

In recognition that digital age universities must necessarily anticipate and advance capabilities requisite to faculty and student 'knowledge making' throughout a lifetime, campus stakeholders also created a 'zone of innovation' to explore futuristic strategies for furthering knowledge creation in student learning communities (Somerville & Gillette 2008). Through formal and informal interactions fortified by concrete experiences, reflective observation, abstract conceptualization, and active experimentation, R&D activities in the 'zone of innovation' furthered the development of students' problem solving, teamwork, negotiation skills, and interpersonal communication.

The Lumiere Ghosting Project, for instance, used virtual reality production technologies grounded in collaborative learning principles to facilitate social exchanges in which information is transformed into knowledge. In this experimental one-year initiative, creative learning relationships among professors, librarians, instructional designers, and technologists advanced the knowledge, skills, and abilities underpinning knowledge creation and knowledge integration as a social activity which, when actively enabled, advances learning within

intentional communities. The pedagogical practices cultivated effective learning, understanding, and reflection, thereby encouraging higher-order thinking and deep learning conducive to knowledge enablement through the social interaction driving construction of knowledge and negotiation of meaning (Gillette & Somerville 2006).

Typical of all the Cal Poly co-design projects, students worked in teams. Learning advanced by addressing real world problems (and opportunities). A variety of user-centric human-computer interaction (HCI) and human-information interaction (HII) research methodologies were employed. And, throughout, librarians provided coaching services on demand - explicating information searching, evaluating, organizing, and disseminating strategies. In turn, they learned from students about non-bibliographically controlled sources of authoritative information and, as well, social networking and peer knowledge production technologies.

Such scenarios offer a number of important benefits. First, data collection and interpretation required considerable face-to-face communication between librarians and students. These clarifying dialogues offered librarians valuable insights into user perspectives – and fulfilled the Interaction Age requirement for engagement around information. In addition, librarians' relationships with the students oftentimes continued beyond the quarter, fostering the ongoing communication which informed librarians' understanding over time of users' perspectives on a wide range of library issues. This collaborative approach naturally encouraged continuous organizational improvements, even as it fostered sustainable relationships with members of diverse campus communities. And, finally, ongoing conversations now continue library wide rethinking and re-orientation, toward the goal of continuing to improve the library's alignment with the university's learning, teaching, and research priorities (Davis & Somerville 2006).

Co-Design Fundamentals

As the preceding examples illustrate, when co-design is customized to the cultural and political realities of an organization, it offers considerable promise for better aligning library performance outcomes and organizational priorities with changing information seeking and knowledge creation practices. Ideally, these co-design activities also stimulate collaborations that initiate relationships and enable learning among library staff and with library users.

Various interactive, user-centered design (UCD) methodologies can be employed, according to specific projects' needs. While quantitative research methods were sometimes used, research methodologies typically emphasized:

- Qualitative data collection and analysis methodologies such as open ended interviews, focus groups, ethnographic studies, and participant observation and
- Interactive design processes for rapid prototyping of solutions that were, in turn, evaluated, modified, and implemented – by incorporating user feedback - in a relatively short time frame.

In addition, informed and fortified by dialogue between librarians and users, co-design activities were characterized by:

- A process: user-centric, interdisciplinary, iterative investigations and
- An outcome: usable products, applications, environments.

Participatory co-design anticipates that changing circumstances will require redefinition of libraries' roles, goals, and methods. And it assumes that user-generated recommendations can offer valuable insights into repurposing and retooling priorities. Finally, co-design offers a promising approach for establishing a culture of transformative, dialogue-based collaborative design and development.

In such a workplace environment, librarians converse with users in the spirit of appreciative inquiry. Conversations entertain diverse perspectives and contexts. These relationship building processes produce two-way empathy and insight. At the same time, this approach places users' learning at the center,

aiding their discovery of appropriate methods for acquiring, interpreting, and applying knowledge. In addition, staff members' growing familiarity with digital age tools improves their continued relevancy as – in partnership with beneficiaries – they evolve innovative, interactive approaches that enables knowledge creation.

Concluding Reflections

Participatory co-design reflects the fundamental shift in higher education from an emphasis on teaching to a focus on learning. This approach also acknowledge that today's generation of students must be able information consumers, as well as knowledge producers. The resulting new student-centered learning outcomes and performance assessment measures require reconsideration of the traditional non-consultative approach to educational design and delivery strategies. These converging factors also compel librarians to might move from 'library-centric' to 'user-centered' decision making processes which can advance students' knowledge production capabilities.

The co-design concept offers a promising approach for meeting students in virtual and physical environments, social and academic contexts, and individual and community settings. This design philosophy required inclusive communication and consultative decision-making. In addition, the organizational culture must encourage staff members to act as catalysts for change and experimentation within the library and throughout the university. Such an organizational development approach, which enables knowledge creation among library staff so that they can better (co)create information-rich learning environments through interactions with and for users (Somerville 2006), hold considerable promise for advancing academic library centrality and thereby reaching the unreachable in the Knowledge Age.

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