I. (PEDAGOGY TRACK): CSCL IN THE BROADER SOCIAL CONTEXT

Web Resource Collaboration Center (WRCC): An Integrated Tool to Support Lifelong Learning

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ABSTRACT

Influenced by EPSS, generative learning, and intentional learning strategies, a Web-based tool – called the Web Resource Collaboration Center (WRCC) – was developed to support learning communities in building their own Web-based learning and performance support systems to support lifelong learning and professional development. Using various online communication and collaboration technologies, the WRCC is designed to not only enable learning communities to (1) build a learning and professional development resource that will provide them with immediate support and guidance and (2) help them develop structure, strategies, and skills for subsequent lifelong learning and professional development activities, but also (3) take responsibility for creating original resources that support lifelong learning and professional development.

Keywords

Lifelong learning, professional development, learning communities, EPSS, generative and intentional learning

INTRODUCTION

In the present climate of continual change and innovation, developing lifelong learning skills is a critical educational goal. To keep current in their fields, people have to be willing and able to continually update their knowledge and skills. The need for continuous learning is especially apparent in ill-structured domains—such as medicine, law, business, engineering, and information technology – because of the overwhelming explosion of information and technological advances. At the same time, employers want employees who can "retool" overnight; if organizational needs change at the speed of sound, then employees need to become lifelong learners and keep up with the pace. Many people look to the Web as an on-demand source to support lifelong learning and professional development activities. However, the Web itself is not necessarily designed to efficiently or effectively support these activities; Web resources are not organized by specific project, problem of practice, context, or domain, making it difficult to find what you need when you need it.

Although employees' ability to engage in lifelong learning and professional development has a direct impact on an organization's effectiveness in today's ever-changing marketplace, many employers have neglected the development of the skills needed to engage in perpetual learning activities. Organizations rely on short-term solutions, such as conventional training where trainers impart knowledge and procedures to employees using canned, inflexible instructional materials that often do not reflect the true complexity of an ever-changing work environment. (Unfortunately, this is the case whether we are describing instructor-led, computer-based, or Web-based training.) After the training activity is over, employees struggle with applying what they learned from their training experience to the demands of their jobs. Not only does the conventional training solution not accurately represent the on-the-job performance requirements, but also it does not prepare the employees to:

- Transfer the knowledge and skills to their specific job requirements,
- Extend the knowledge and skills presented during training to address increasingly complex job requirements, or
- Update the knowledge and skills presented during training when their job requirements change or the knowledge and skills change.

To address these shortcomings, some organizations have implemented electronic performance support systems (EPSS) to replace or augment conventional training. An EPSS is an integrated database of information, tools, learning experiences, resources, and guidance/advise designed to help people learn how to perform a task just-in-time and in context (e.g., on-the-job).

However, the problem with conventional training is also, in part, the problem with EPSS – as I discovered firsthand while working with the organization described below. Instructional designers working with content experts typically develop EPSS products. They create all of the tools, references, job aids, and tutorials to meet the generic needs of all the individuals who will access it. EPSS limits individualization because it assumes that everyone who needs to access the EPSS has the same performance issues, learning needs, and learning preferences. Issues of transfer, extension, and updating are not effectively addressed by EPSS. In addition, like with conventional training solutions, all of the higher-order

thinking, problem-solving, and decision-making that goes into creating the "content" of an EPSS — all of the activity that helps people develop domain-specific lifelong learning skills — is done by the development team.

Facing the Challenge

A few years ago, I was hired by an information technology organization (let's call it *ITO*) to "get to the bottom" of why its elaborate EPSS which was available on the company's intranet was not being utilized by employees. The company had used its training and development resources to build this EPSS to help employees keep up with all of the new technologies they were expected to master for the various projects the organization was taking on. Since a front-end analysis was not actually conducted before the development of the EPSS (the decisions were made based on anecdotal information and a desire to use "cool" technology, which many of us are guilty of at some point in our development work), this is where I started. The employees liked that the EPSS provided a variety of resources (e.g., tutorials, white papers, job aids, business cases, etc.) to support their various learning needs and preferences. Instead of conventional training (which could not help them keep up with their changing needs), they wanted access to learning and professional development resources that would help them keep their knowledge and skills "cutting edge". So, although they were not against the idea of an EPSS, they did not believe that the developers of the EPSS understood what resources they needed, and certainly did not know how to present them in contextualized ways (e.g., resources that would help with one type of project vs. another type of project). They were also concerned that there was no way to capture the "here's how I did it" expertise of the people in the organization, and in the external community of practice. In addition, the EPSS was static – the information and tools related to the technologies these employees were using was constantly evolving and being upgraded. The most up-to-date information was being distributed on the Web. The EPSS was not dynamic enough to capture those changes, so the employees were using the Web to support their learning and professional development – albeit not very efficiently, which led to frustration. Bottom line, they had been cut out of the process, and believed that they were better judges of what was needed to support their learning and work.

This consultation led to my interest in developing a tool that would (1) take advantage of some of the structural qualities of EPSS, (2) harness the resources on the Web (since it was a distribution source for some of the most up-to-date information and tools), and (3) provide a structure for learning communities and communities of practice to build their own unique content to support both lifelong learning and professional development activities. To meet this challenge, we created a Web-based development tool called the Web Resource Collaboration Center (WRCC). This tool was designed to help learners take advantage of the wealth of resources available on the Web during on-the-job professional development as well as lifelong learning activities. Influenced structurally by EPSS and conceptually by generative and intentional learning strategies, the WRCC provides a structure for people in workplace and educational settings to generate their own, collaboratively built Web-based learning and performance support systems. After a number of redesign iterations based on continual needs assessments and formative evaluations with both organizational and higher education groups, the WRCC has been implemented in over ten settings. This paper describes the WRCC design decisions, and reports on the use of this tool with three specific learning communities.

STRUCTURAL AND CONCEPTIONAL FOUNDATIONS FOR THE WRCC

Based on my work with the ITO learning community, EPSS seemed to provide a good structural starting place as a way of organizing Web resources because it:

4. Provides an integrated database of learning and professional development resources;
5. Provides access to a variety of different resources to support people with different learning needs, preferences, maturity, style, and expertise; and
6. Is designed to help people learn in context, while they are on the job or working on a particular problem (although, because of the over-generalization of the content, EPSS does not do this well).

However, it still did not adequately address the need for knowledge building by the community itself to support their specific lifelong learning and professional development needs. Therefore, I turned to the literature for conceptual guidance. This led me to generative learning and intentional learning.

Generative Learning

Generative learning directs students to take responsibility for determining what it is about a particular domain they need to know, and then directs their activities accordingly to effectively research, synthesize, and present their findings (Cognition and Technology Group at Vanderbilt, 1992; Hannafin, 1992). Some generative learning activities provide students with a context or situation requiring them to take action (e.g., a problem that needs to be solved or a case that needs to be analyzed). Other types of generative learning activities require students to determine what it is about a particular content area they wish to know, and then take responsibility for answering their own questions through research and synthesis and representing the acquired knowledge in an organized and accessible way. This process of "generating" knowledge – instead of passively receiving information – helps learners develop structure, strategies, and habit for lifelong learning.

Schank and Jona (1991) describe generative learning in their discussion on the research method of teaching. Under the research method of teaching, students are asked to research a particular topic and then present their results to others (the class, a collaborative group, etc.). In this way, students are taking over the responsibility of information gathering, synthesis, and dissemination/presentation from the teacher. For this teaching method to lead to successful learning, students need to be allowed to select their own topics to research and report on, so that they have a real interest in proceeding with the assignment and have more control over their learning. Teachers often have to help students find something to research that is relevant and meaningful to them while still meeting learning objectives and outcomes – this requires strong teacher guidance, coaching, and scaffolding. Because students are responsible for selecting a topic, developing a question to research, making decisions about how to gather information, analyzing and synthesizing information, etc., they are engaging in activities that help to develop high-level thinking and problem solving abilities (Bruner, 1961).

Intentional Learning

Intentional learning requires learners to be actively in control of the learning process (Resnick, 1989). Palincsar and Klenk (1992) describe intentional learning as an achievement resulting from the learner's purposeful, effortful, self-regulated, and active engagement; it refers to the "cognitive processes that have learning as a goal rather than an incidental outcome" (Bereiter & Scardamalia, 1989, p. 363). Intentional learning's objective is to create a supportive structure in which students can engage in cooperative knowledge building as they move towards greater autonomy. Addressing students' need for higher-order thinking and learning skills, intentional learning helps students develop the general metacognitive and self-directed learning skills that facilitate autonomous lifelong learning (Palincsar, 1990; Scardamalia, Bereiter, McLean, Swallow, & Woodruff, 1989), specifically the abilities to:

- Monitor and assess how they learn, think, and solve problems, and make adjustments when necessary;
- Make maximum use of existing knowledge;
- Ask questions to identify knowledge deficits and set personal learning goals to address those deficits;
- Utilize learning strategies other than rehearsal to attain learning goals;
- Access, apply, and evaluate appropriate resources, including peers and teachers; and
- Manage the learning process (e.g., set goals, create action plans, identify appropriate learning strategies).

Students develop these skills by engaging in situations in which they need to build a body of knowledge based on their learning interests using a variety of information resources. Structure and teacher facilitation is provided throughout the knowledge building process to prompt, assess, and redirect – if necessary – students; again, like in generative learning settings, the teacher is very involved in guiding, coaching, and scaffolding students to ensure intentional learning outcomes. While building the knowledge base, students practice tactics for making claims, collecting evidence in support of their claims, and evaluating and responding to counterarguments from peers and teachers. Through this knowledge-building process, students reflect on specific aspects of their learning and thinking processes, and consider the effects of collaboration on each other's learning, such as the impact of opinion, bias, controversy, debate, and negotiation (Glaser, 1991).

Additionally, intentional learning prepares students for self-directed learning activities by helping them learn how to ask questions based on personal knowledge deficits and formulate learning goals to address those deficits. Research by Scardamalia and Bereiter (1991) indicates that students can learn to ask questions to guide their knowledge building, thus assuming more control and ownership over their learning activities. Because intentional learning emphasizes question generation to guide goal attainment, students acquire ownership over learning activities, find personal relevance during learning activities, and develop skills needed to be lifelong learners.

Common Instructional Strategies to Support WRCC Design Decisions

Generative and intentional learning approaches employ common instructional strategies to encourage lifelong learning and contextualized, relevant knowledge building. These strategies had a direct influence on the specific design components and use of the WRCC, specifically learner autonomy, collaboration, and reflection.

Learner Autonomy

To be autonomous learners, people have to know how to plan their learning: address learning needs, set learning objectives, employ learning strategies, utilize resources, and assess the overall process. They need to acquire more agency over their zones of proximal development by being self-directed learners. Barrows (1986) defines the process of self-directed learning as utilizing the following skills:

1. Identify and define a problem/learning need;
2. Identify, find, use, and critique resources for solving the problem or meeting the learning requirement;
3. Capture and apply information from resources to the problem or learning need; and

4. Critique information, skills, and processes used to solve the problem or meet the learning requirement (an especially important skill for using the Web).

Collaboration

Learning takes place in a social context; higher cognitive processes originate from social interactions (Vygotsky, 1978), with knowledge acquisition "firmly embedded in the social and emotional context in which learning takes place" (Lebow, 1993, p. 6). Conversation, communication, and establishing a community of learners are critical to the teaching and learning process (Pask, 1975). Collaboration:

1 Elevates thinking, learning, and problem solving to an observable status (Glaser, 1991), making students' metacognitive processes apparent. This provides students with opportunities for understanding and sharing these processes — refining, strengthening, and extending their metacognitive skills (Von Wright, 1992).

2 Gives rise synergistically to insights and solutions that would not come about individually; learners working together collaboratively can often successfully tackle complex problems that individuals working alone would not be able to handle.

3 Displays multiple viewpoints leading to the conceptual growth that comes from sharing perspectives and testing ideas with others (Bednar, Cunningham, Duffy, & Perry, 1991).

Reflection

The process of reflection is the ability to think about one's self as an intentional subject of personal actions and to consider the consequences and efficacy of those actions (Von Wright, 1992). This involves the ability to look at one's self in an objective way and to consider ways of changing to improve performance; in other words, it requires metacognitive skills. Von Wright (1992) defines metacognitive skills as "the steps that people take to regulate and modify the progress of their cognitive activity: to learn such skills is to acquire procedures which regulate cognitive processes" (p.64). Metacognitive skills include taking conscious control of learning, planning and selecting strategies, monitoring the progress of learning, correcting errors, analyzing the effectiveness of learning strategies, and changing learning behaviors and strategies when necessary (Ridley, Schultz, Glanz, & Weinstein, 1992).

THE WRCC COMPONENTS

After determining the structural and conceptual frameworks based on front-end analysis and a review of the literature, I started working with a computer programmer to develop a tool for learning communities to use to build their own lifelong learning and professional development systems. After a number of implementation and feedback iterations with organizational and higher education groups, we chose the best – at least for the moment – configuration of EPSS structure and generative and intentional learning strategies.

By creating a structure that supports collaborative knowledge building by the people who will actually be using the knowledge, the higher-order thinking, problem-solving, and decision-making involved in the selection and utilization of appropriate learning materials and performance support is done by those who can get the most out of the process. Additionally, because these activities happen within the framework of a learning community and are driven by the needs of the job, challenge, or interest at hand, the learning activities are contextualized, authentic, and meaningful. Therefore, the WRCC was designed to meet the following goals:

- Learning community members learn about the domain while they are locating, evaluating (which requires utilization of resources), organizing, and creating resources to support their learning and job performance activities – making the process relevant and productive;
- The content of the WRCC is information which has been applied/articulated from the perspective of reflective practice, making the WRCC a knowledge management forum;
- The WRCC is developed by and for the people involved in the project, challenge, context, or domain;
- Because the learning community controls the content, the WRCC can change and adapt based on the changing learning or professional development needs; and
- Once a WRCC is developed it can be used to support continued learning and professional development.

In this way, the WRCC was designed to not only enable a learning community to build a learning and professional development resource that will provide members with immediate support and guidance, but also help them develop structure, strategies, and skills for subsequent lifelong learning and professional development activities.

To provide a structure for these activities, the WRCC is broken into three EPSS-influenced functional areas that support the common instructional strategies – learner autonomy, collaboration, and reflection – prescribed by generative and intentional learning methodologies. The three functional areas are the Discussion Forum, the Link Manager, and the Resource

Construction System. [Note: These tools – written entirely in Perl – are not unique – there are similar tools available from a variety of sources. The impact is in the use and integration of the tools, and the fact that they are Open Source.]

The Discussion Forum

The Discussion Forum provides a structure for capturing the "here's how I did it" expertise that exists within the learning community itself, as well as information that is unique to the community (see Figure 1). Using the Discussion Forum, learners can post questions, issues, problems, etc., and receive feedback from other WRCC participants. It enables learning community members to work together to share ideas and work through challenges. It also provides a forum for coaching and mentoring activities.

Figure 1. Practitioner forum for JavaScript and PHP programmers

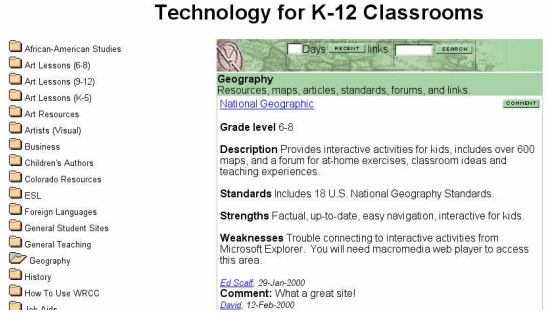
The Link Manager

The Link Manager helps learners collaboratively categorize, assess, and utilize Web-based resources. Learners use the Link Manager to categorize and critique resources found on the Web (see Figure 2). When a resource on the Web is added to the Link Manager, specific information (determined by the learning community based on their purpose) must be added, such as:

- The name and URL of the resource
- A description of the site
- Learning and/or professional development need/s addresses
- Type of learning supported and/or the complexity level of the site
- The site's strengths and weaknesses

Administrators who have different needs are able to customize the Link Manger to request different information from people submitting links. For example, the complexity level, strengths and weaknesses could easily be replaced with a single text area asking for a critique of the site and a popup menu with the options "thumbs up" and "thumbs down".

Figure 2. Example of the Link Manager completed entry



Resource Construction System

Sometimes there are learning and performance needs that cannot be effectively addressed using existing Web resources. This may be because the learning or performance need revolves around a new technology, or an organization-specific issue

not well represented on the Web. Or, resources may be available on the Web, but not in a format that is effective for all learners. To address this issue, the WRCC provides a learner-centered tool for developing unique resources – the Resource Construction System (RCS).

The RCS combines the technologies of document sharing and asynchronous threaded communication to create an environment in which learners can collaboratively develop – from scratch – their own Web-based resources.

The document-sharing feature:

1. Enables learners to track and archive various versions of new resource documents,
2. Utilizes asynchronous threaded discussion technology to allow reflective discussion around the development of new Web-based resources, and
3. Provides easy uploading and downloading of resource documents for revision purposes.

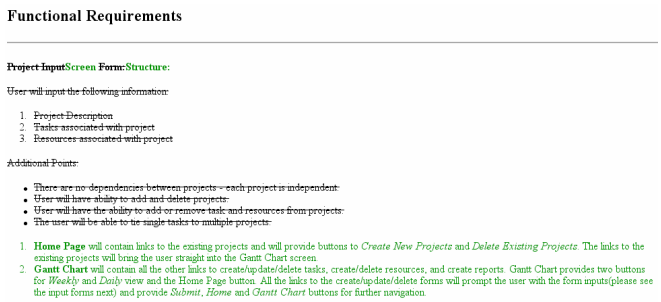
The RCS allows the learning community to build their own Web resources online. To accomplish this a learner must first create a Project on the system. Once a project is added to the RCS, any number of documents may be added to the project (see Figure 3). Typically, documents added to projects are HTML documents.

Figure 3. Discussion Posting in Resource Construction System

Once a document is added to a project, learners may view the document through the System. Learners collaborate on changes, additions, and deletions that should be made to the document through a threaded discussion forum attached to the document. Once consensus is reached on discussed changes, one of the learners will make the actual changes to the document and then post a new revision to the RCS. The collaboration process then repeats for the new revision of the document if necessary. Each revision of a document has its own discussion forum. When browsing a project, learners are not only able to see any revision of a document, but they also see the historical discussion that took place over an older revision and may participate in the discussion of a current revision.

The RCS is very intelligent when handling HTML documents. When a new revision of an HTML document is added to the RCS, the RCS internally calculates the differences between the previous revision and the newly checked-in revision. As with any type of document, when a learner clicks on a revision's icon, they see the rendered document in a separate window. However, with HTML documents, if they click on the revision icon a second time, learners see the annotated version of new revision. Any text removed from the previous revision is shown in strikethrough text, and any text added to the previous revision is shown in a green font (see Figure 4).

Figure 4. Example of document under construction in the Resource Construction System



HTML documents frequently have images embedded within them and may have other media embedded (such as background music or a Shockwave plug-in). The RCS supports this by allowing learners to "attach" media to a given

document so that the document renders correctly when presented to learners. Although the RCS only annotates the differences between revisions of HTML documents, the RCS is capable of managing revisions of any type of document. Examples of different documents learners could collaborate on and revise include images, audio, video, PDF files, Microsoft Word documents, etc. Figure 3 shows the "Sam-I-Am" team working on HTML, text, and image documents to support their software design project.

Summary

The WRCC provides a structure for learning communities to engage in active knowledge building and collaborative construction of new resources based on specific lifelong learning and professional development goals and needs. It does this by employing the instructional strategies prescribed by generative and intentional learning – namely, learner autonomy, collaboration, and reflection – within an EPSS-like structure (see Table 1).

Table 1. Relationship of generative and intentional learning strategies to WRCC functional areas

	Discussion Forum	Link Manager	Resource Construction System
Learner Autonomy	Learners ask questions based on their own goals and needs.	Supports goal-driven activity: learners add to and access the Link Manager to locate resources to support learning goals. Learners decide what is included and excluded from the resource database. Provides access to variety of learning resources based on learning needs, goals, strategies, and preferences, and level of expertise/maturity.	Based on the needs and goals of the learners building the WRCC, learners determine what additional resources need to be built for inclusion in the Link Manager.
Collaboration	Learners are exposed to a variety of ideas, solutions, and perspectives because of the collaborative setting.	Guiding collaborative knowledge building: Because people are building the WRCC collaboratively, a variety of resources are collected and annotated based on different learning preference and stages. Building the content of the WRCC is a collaborative knowledge building process. The Link Manager is directly impacted by the extent to which the community actively contributes.	Learners work together to build new resources for inclusion in the Link Manager.
Reflection	Learners must reflect on what they know and don't know. To contribute to the community, learners must articulate and elaborate their understanding.	Learners annotate other's contributions, so the information about each Web resource continues to grow based on reflective use and practice.	Determining what new resources need to be created requires reflection (what new resource is required, who is the resource for, what is the best way to present the resource, etc.).

USE AND IMPACT OF WRCC

The WRCC has been implemented in both work-based learning communities – also referred to as communities of practice – as well as school-based learning communities (Gordin, Gomez, Pea, & Fishman, 1996). This means that the people who use the WRCC have a common purpose and share some background, language, or experience (Hildreth, Kimble, & Wright, 1998). For example, the WRCC has been used:

1. To support communities of practice in two information technology organizations and one training and development company (examples not provided due to proprietary content concerns);
2. To support school-based learning communities in both face-to-face and online programs at three different higher education institutions;
   (1) To support a hybrid learning community of K-12 teachers focused on technology integration issues in Colorado (http://carbon.cudenver.edu/public/wle/wrcc/techfork12/).

In all implementations of the WRCC so far, learning community involvement has been facilitated by me (as a consultant or faculty member) or by another faculty member. As prescribed by generative and intentional learning methods, this facilitation involves teaching people how to use the tool as well as guiding, coaching, and scaffolding their use until the community members are using and contributing to the WRCC without reminding or prompting from the facilitator (this period of facilitation also allows me to collect formative evaluation data to adjust the tool to better support lifelong learning and professional development needs in learning community settings).

Data Collection

Using pre and post questionnaires and WRCC log-in information, I collected data on three learning communities (one work-based, one school-based, and one hybrid) I facilitated to use the WRCC over a four month period in the spring of 2001 to answer the following questions:

- Can the facilitated use of the WRCC in a learning community setting lead to improved use of the Web – without the WRCC structure or facilitation – for learning and professional development activities?

- Can use of the WRCC for lifelong learning and professional development activities in a learning community setting lead to the development of some transferable lifelong learning skills: goal/need determination, action planning, learning strategy selection, and resource evaluation?
- Can facilitated use of the WRCC in a learning community setting lead to continued use – where *use* means continued utilization of the pre-existing resources and the addition of new resources – of the WRCC after the facilitation is removed?

Results

Work-based learning community: Information Technology Project Team

This community of practice had 11 participants who all actively participated in the WRCC during a software development project (although the project lasted much longer, my facilitation of their WRCC activities only lasted four months). Nine of the 11 original members continued to use and contribute to the Discussion Forum and Link Manager of the WRCC after my facilitation ended (the two members who discontinued had been transferred to a different project). The WRCC experience, as reported on a questionnaire, had a positive impact on how they used colleagues and technical texts as resources. Regarding use of colleagues, for example, the group reported being much more selective and specific about what questions they took to colleagues, as well as when they turned to colleagues for help; instead of going to a colleague down the hall immediately, the group was using each other and the WRCC for support first. In addition, when they did go to an external source for support, the members made an effort to capture the information for inclusion in the WRCC using the Resource Construction System.

School-based learning community: Web Developers

Fourteen graduate students preparing for careers as Web-based instructional designers participated in a semester-long, school-based learning community. During the semester, all members participated in building the content of the WRCC. After the semester was over – and my facilitation ended – only three members continued to contribute resources to the Link Manager, although all of them continued to access the WRCC and utilized the existing resources (from both Discussion Forum and Link Manager). In addition, over 300 peripheral participants (Lave & Wenger, 1991) have accessed the WRCC, with many people adding a link from their own Websites to it. Questionnaire results revealed very little impact on transferable lifelong learning skills; when using the Web outside of the WRCC structure, students reported more efficient searching skills based on higher order questions and more specific goal setting, but did not apply these strategies to library or colleague use.

Hybrid learning community: K-12 Teachers

This community of 19 participants was both a school-based and work-based learning community; although these teachers were involved in a graduate program at the time, they were actively participating in different communities of practice focused on technology integration in the classroom. During the four-month period, all members contributed and used all components of the WRCC. After my facilitation was removed, all but two members continued to access the WRCC, but only six of the original 19 continued to contribute to it. Additionally, over 200 peripheral participants have accessed the WRCC's Link Manager (although they did not add to the Link Manager). From the pre and post questions that asked the community members to describe their use of the Web to support learning and professional development activities, the WRCC experience did have an impact on their use of the Web, specifically how they searched for resources, how the evaluated resources, and how they used resources to support their needs. However, only three of the participants indicated a similar impact on their non-Web resource use; the majority of the group did not indicate making adjustments to how they used library or human resources.

Summary of Results

Consistently, the WRCC experience seemed to have a positive impact on continued, non-facilitated, non WRCC-structured use of the Web to support learning and professional development activities. Unfortunately, only the ITO group reported any improvement on their strategies when using non-Web resources (such as texts and colleagues). It is also discouraging to see that the school-based and hybrid learning communities no longer added to the Link Manager or Discussion Forum after facilitation faded. This may be due to discontinued facilitation, the end of the semester/grading period (although students did not receive a grade for participation), or diminished need to participate in the community. An interesting side effect seems to be the peripheral participation that happened once each of the two "open to the public" WRCCs were developed by the Web Developers and the K-12 Teachers, respectively.

DIRECTIONS FOR FUTURE RESEARCH

The development and implementation of the WRCC, and the initial examination of its impact on participants described above, leads to new directions for research. My immediate focus is on:

1. The impact of facilitation. Facilitation was included in the WRCC implementations because I followed the prescriptions of generative and intentional learning. However, would learning communities spontaneously use tools like the WRCC without initial facilitation? Can learning community members provide referents for contribution without someone initially acting as facilitator?
2. The difference between project-specific communities of practice (which may have more of an emphasis on workplace learning and on-the-job training as opposed to lifelong learning and professional development) and learning communities that form because of a common challenge (e.g., the K-12 teachers working together on technology integration issues) or interest (e.g., folks who participate in Slashdot.com).
3. Ways to improve the transfer of the lifelong learning skills being promoted through facilitated use of the WRCC to unfacilitated learning and professional development activities.
4. What would the results be if the participants had not been co-located? All three groups had face-to-face time with each other. Although the WRCC has been implemented in school-based distance learning communities, I have not explored my original research questions with these groups.

CONCLUSION

While creating their own WRCC to support their learning and professional development, learning community members practice and develop the very skills and strategies needed to engage in lifelong learning and professional development activities. The WRCC was designed to enable people to develop their own Web-based knowledge bases and learning and performance support systems. The activity of building a WRCC helps people learn about a domain, construct a knowledge base to support their future learning and professional development in that domain. Although further research is needed – leading to further improvements to the tool and facilitation of the tool's use – the WRCC shows promise as a tool to help learning community members develop the skills, strategies, and structure needed to engage in the type of lifelong learning and professional development activities that will help them stay current in their professions. [Note: To take a WRCC test drive or get your own copy, see http://carbon.cudenver.edu/~jdunlap/wrcc/]

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