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Towards a Learning Organization Model for PBL: A Virtual Organizing Scenario of Knowledge Synthesis

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Abstract

This paper describes a learning organization model to support the pedagogy of problem-based learning (PBL) as an approach to conduct teaching in the author's undergraduate curriculum development. Specifically, an organizational scenario is described to support the PBL method of course delivery, through an action research report on some of the progress involved in setting up a Centre for PBL Research in the author's affiliated Faculty. This Centre, designed to be operationalized through a virtual organizing effort, could be considered as an important effort in information systems (IS) design which encourages individual organizational units within the university, to provide suitable electronic services towards the realization of a virtual university.

Keywords: Learning Organization, Problem-Based Learning, Virtual Organizing

Introduction

As demonstrated in numerous studies (Evensen and Hmelo, 2000), problem-based learning (PBL) is a kind of group-based project work, which is recognized as having many educational and social benefits, in particular providing students with opportunities for active learning. However, teaching, directing and managing such project work is not an easy process. This is because projects are often: expensive demanding considerable supervision and technical resources; and complex combining design, human communication, human-computer interaction, and technology to satisfy objectives ranging from consolidation of technical skills through provoking insight into organizational practice, teamwork and professional issues, to inculcating academic discipline and presentation skills. In preparing our students to get started with group-based project work, we need some sort of course support whose characteristics must be delineated and thoughtfully designed in a practical learning scenario in order to stimulate any learner-centred involvements. This paper discusses the learning organization model (Senge, 1990) behind providing such course support, through describing an effort in setting up a Centre for PBL Research whose operations are to be actualized through the architectural efforts of virtual organizing (Venkatraman and Henderson, 1998). Of importance here is a description of the Centre's mission to promote PBL through encouraging self-direction and learner-control in the students, and to provide support to teaching staff who are interested in adopting PBL in their course delivery. The paper concludes by discussing the organizational context of the virtual university, in terms of its vision, the renewed mindset for education, and some challenges in the underlying support for information and communications technologies.

The Learning Organization Ideal

The idea of *learning organization* was popularized by Peter Senge (1990), in his seminal work *The Fifth Discipline: The Art and Practice of the Learning Organization.* Senge describes a learning organization as a place where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together. At the core of the learning organization are five essential learning disciplines: personal mastery, mental models, shared vision, team learning, and systems thinking, that may be briefly described as follows. Personal mastery has to do with individual learning, and can be seen as the basic building block through the actualization of which the learning organization is constructed. Mental models are about how individuals reflect on their own knowledge, using such models to improve the internal understanding of an

organization's functions, and processes. Shared vision implies a sense of group commitment to a matrix of organizational goals, while team learning describes a sharing and utilization of knowledge involving collective thinking skills. The purpose of systems thinking is to understand relationships and interrelationships, as well as the context and the forces that affect the behaviour of a system or organization. For the early half of the 1990s, the idea of learning organization had been criticized as the mere re-incarnation of earlier ideologies, such as organization development and total quality management (Rasmussen, 1997). Nonetheless, as more entities adopt the practices underlying the learning organization, it appears that the learning organization concept is passing from buzzword status to a meaningful expression of best organizational practices. Today, most authors in the management field agree that the learning organization is best viewed as an ideal, a model toward which an organization should strive, and that certainly no existing organization perfectly fits the model (Benson, 1997; Senge et al., 1994; Jashapara, 1993). Meanwhile, many organizations that are engaged in constantly revamping and retooling themselves may be seen as reaching for that ideal goal of learning organizations. In fact, in this modern age of information technology and swift change, learning has become an integral part of the work of an organization (Willard, 1994), run along principles intended to encourage constant reshaping and change.

The PBL Paradigm of Learning

Problem-based learning, according to Bruer (1993) and Barrows (1986), is designed to actively engage our students, divided in groups, in opportunities for knowledge seeking, for problem solving, and for the collaborating necessary for effective practice. At the heart of PBL is a set of group-based activities, including climate setting, starting a problem, following up the problem, and reflecting on the problem (Barrows, 1985, 1988). A brief description of the PBL model of investigation could be presented as follows.

The Climate Setting Phase

At the outset, before the PBL group work begins, students must get to know one another, establish ground rules, and help create a comfortable climate for collaborative learning. Meeting in a small group for the first time, students typically introduce themselves, stressing their academic backgrounds to allow facilitators and each other to understand what expertise might potentially be distributed in the group. The most important task is to establish a non-judgmental climate in which students recognize and articulate what they know and what they do not know.

The Problem Initiation Phase

The actual PBL episode begins by presenting a group of students with minimal information about a particular problem. The students then query the given materials to determine what information is available and what they still need to know and to learn to solve the problem. During this phase, students typically take on specific roles. An example is the scribe, who records the group problem solving, including listing the facts known about the problem, students ideas, additional questions about the problem, and the learning issues generated throughout ensuing discussion. Such written record helps the students keep track of their problem solving and provides a focus for negotiation and reflection. Throughout the problem-solving process, students are encouraged to pause to reflect on the data collected, generating additional questions about that data, and hypothesizing about the problem and about possible solutions. Early in the PBL process, the facilitator may question students to help them realize what they do not understand. As students become more experienced with the PBL method and take on more of the responsibility for identifying learning issues, the facilitator is able to fade this type of support, or scaffolding. After the group has developed its initial understanding of the problem, the students divide up and independently research the learning issues they have identified. The learning issues define the group learning goals and help group-members work toward a set of shared objectives. These objectives can also help the facilitator to monitor the group progress and to remind members when they are getting off course, or alternately, to ask if they need to revise their goals.

The Problem Follow-up Phase

In the problem follow-up phase, students re-convene to share what they have learned, to re-consider their hypotheses, or to generate new hypotheses in light of their new learning. These further analyses, and accompanying ideas about solutions, allow students to apply their newly acquired knowledge to the problem. Students share what they have learned with the group as they interpret the problem through the lens of their newly accessed information. At this point, it is important for the students to evaluate their own information and that of the others in their group. In the PBL group, information is not often accepted at face value. Students must discuss how they acquired their information and critique their resources. This process is an important means of helping the students become self-directed learners.

The Problem Reflection Phase

During post-problem reflection, students deliberately reflect on the problem to abstract the lessons learned. They consider the connections between the current problem and previous problems, considering how this problem is similar to and different from other problems. This reflection allows them to make generalizations and to understand when this knowledge can be applied [Salomon and Perkins 1989]. Finally, as the students evaluate their own performance and that of their peers, they reflect on the effectiveness of their self-directed learning and their collaborative problem solving.

The Idea of the *Centre* for PBL Research

Accordingly, we begin our discussion by assuming that at the Faculty of Science and Technology of the author's affiliated University, an evolutionary process of institutional innovation is occurring. Under the name of the *PBL Initiative*, we have made a commitment to blend the best of our old values of good teaching with problem-based learning (PBL) as well as technologies so that we can extend our already unique curriculum and instructional practice over the Internet, through a continually renewed Web-based course support, both for the teaching staff and for the student community. Specifically, we are to create the *Centre for PBL Research* (referred to as the Centre) in cooperation with the Department of Computer and Information Science (CIS), to promote and coordinate the PBL efforts in the undergraduate programs, offering degrees at the Bachelor level. The most important mission of this Centre is to re-engineer most of our undergraduate courses in the Department for the PBL initiative, to produce PBL project cases in terms of course reports for curriculum development and evaluation, and to manage the accrued knowledge resources of both teachers and students in terms of their contributions into the course support environment. The Centre is also expected to produce PBL-based course materials and research reports on an ongoing basis through a coordinated cycle of academic efforts jointly exerted by the respective teaching staff and the student community. It is understood that implementation success in institutional innovation requires many ingredients: administrative vision and courage; the momentum and insight that comes from previous experience; a sound research-based educational framework to motivate educational change; extensive experience with the design, development, and use of computer-related and networked educational tools and environments; a robust technical infrastructure and with high availability to all instructors and students; a culture that rewards innovation and quality in teaching; a strategy for instructor engagement and commitment for change; and more importantly, sufficient support in the leadership positions. Also, some tasks must be pulled together to form specific processes of value to the PBL initiative, whereas other tasks could be considered as major functions for more convenience. It is also likely that most of the tasks are to be executed by workgroups. In order to identify what tasks are necessary for the PBL initiative, we consider the following actionable goals proposed by the Centre.

To provide specific aids to course instructors wishing to join the PBL initiative

The Centre should serve as a resource location for any course instructor who would like to know something about PBL, and what specific PBL design or services could be made available to his or her course delivery. Once agreed, the course instructor could join as the PBL participant of the Centre, which should provide him or her with a consultant in PBL style of learning. The instructor will also be given the opportunity to interact with a task force from the Centre, considered as an aspect of our Faculty engagement strategy, to identify the need for a Web-based course support environment. This environment should serve the needs of both the instructor and the students during the course of their PBL learning. Rapid-prototyping workshops to demonstrate how the ideas of PBL could be employed for group-based project work could then be arranged for further user-driven requirements clarification until the teacher feels comfortable with the technologies of his or her choice.

To manage the accrued knowledge resources contributed by both teacher and students over the PBL study period

The Centre should serve as the administrator for the specific Web-based course support environment in support of PBL teaching. The basic set-up of the course support environment should accommodate the accumulation of course-specific contributions of both the instructor and the students' community. The former could include the general course information, class schedule (including time and location), class resources (including texts, references, Web links, project archives, and course notes), and possibly online class assessment facilities. The latter could include group-based project reports, demos, and presentation videos, plus possibly the ongoing process of team-based records in terms of meetings minutes, and individual members' documents tracking personal progress and responsibilities fulfilled. For every semester, there ought to be some archive to keep track of the course memory related to the specific contributions, as well as the activities performed. This course memory should serve as some precious resources for students in the coming semesters, especially when group-based projects are the themes of PBL.

To help publish PBL-based course materials for curriculum development and evaluation and experience reports for academic research

The Centre should serve as the publisher supporting individual instructors in their efforts to publish their ongoing works in applying PBL to the CIS context. These could include course materials designed for PBL projects, as well as the experience reports in conducting PBL teaching in the various core courses of CIS. To this end, we need the coordination of the teacher-authors, some field experts in the specific areas of CIS education for reviewing purpose, as well as the skills of several editors for publication trimming. Perhaps, the Centre should provide a shared workspace through the Web for such a team to work together in shared editing.

An Organizational Model for the *Centre*

In modeling the organizational unit we call the Centre for PBL Research, we want to represent not just a single organizational form, but also the additional views of the Centre to show other organizational overlays that may be present. Thereby, we choose to include, in our model, a number of organizing constructs such as role, workgroup, function, and process typically affiliated with an organizational unit. Besides, with the advent of the Internet and the Web today, the design and construction of different distributed applications to support the operations of the Centre, must be able to satisfy certain generic concerns posed by modern organizational realities. The following discussion puts into perspective some of those concerns.

The Provision of an Organizational Space

It is believed that a Web portal is needed for the *Centre* as an organizational unit. This portal should lead to a Web-based organizational space for the *Centre*. Such an organizational space should be created to render a number of services to people with specific organizational roles, to accomplish their tasks, be they allocated along the function lines, the process lines, or the workgroup lines. These services are then the potential candidates for distributed applications to be designed, and such services are often conceived according to the mission of the *Centre*. In the context of the information systems (IS) support, we should expect the organizational space is where people with different roles will come to electronically attend to their tasks, with the specific distributed applications provided. A simple expression of the organizational space (OS) for the *Centre*, could then be written as:

$$\mathbf{OS}_{Center} \mathbf{::=} \mathbf{SOS}_{Function} + \mathbf{SOS}_{Process} + \mathbf{SOS}_{Workgroup}$$

This expression is interpreted literally as follows: the organizational space for the *Centre* is composed of several sub-organizational spaces (SOS), for each of the three organizing constructs – function, process, and workgroup. For each of the organizing constructs, a number of distributed applications (DA) are to be conceived to provide services for accomplishing the tasks involved. Likewise, we can further express individual SOS as follows:

$$\mathbf{SOS ::= \{ } DA_i \mathbf{ \} for } i \mathbf{= 0, 1, 2, 3, \ldots}$$

For completeness sake, there should also be a Web-based role space (RS) embedded in the *Centre's* organizational space for personnel with a specific role to embark so as to attend to his or her tasks through the provision of some distributed applications. Also, there could be links from the individual role space to the sub-organizational spaces. Hence, we could add the following expression:

$$\mathbf{RS}_{Individual} \mathbf{::= \{ } DA_i \mathbf{ \} + Linking [SOS}_{Function} \mathbf{+ SOS}_{Process} \mathbf{+ SOS}_{Workgroup} \mathbf{] with } i \mathbf{= 0, 1, 2, 3, \ldots}$$

The Centre's Functions Context

In view of the actionable goals of the Centre, as mentioned previously, we discover a number of functions that could be characterized. First is to maintain a constantly updated Web site for the organizational space OS_{Centre}, to refresh any visitor's understanding of PBL and its application in CIS education. Second is to administrate any instructor's course-based participation in the PBL initiative through some Web-based services. Third is to construct some sample course support prototypes customizable to individual instructor's choice of technologies and services in preparation for the suitable Web-based support for the specific PBL activities in the course enactment. Fourth is to construct and maintain some knowledge management services to keep track of the contributions made by either teacher or students during and after the course. Fifth is to provide some archival service to record the course memory in terms of the activities performed by both the students and the instructor throughout the course duration. Sixth is to help publish any PBL-based course materials developed for reuse in other courses, as well as any experience reports for curriculum evaluation and further refinement.

The Centre's Processes Context

Besides the individual line functions described above, the Centre is set up to support the PBL initiative in terms of several value processes. The first is to develop students' understanding and ability to investigate a question or problem systematically. It is believed that by participating in well-designed problem-based activities, students could learn how to attack similar problems in a comprehensive and systematic manner. The second is the development of self-directed learning among students. It is believed that self-directed learning develops when students are aware of and take control of their learning progress. It is a form of meta-cognition, which involves knowing what we need to know, knowing what we know, knowing what we do not know, and devising strategies to bridge the gap. The third is to enable students in content acquisition. It is believed that much of the content that students learn in PBL is implicit and incidental in the sense that neither the teacher nor the students know exactly where the investigation will proceed. However, there is some evidence that information learned in the PBL way is retained longer and transfers better (Duffy and Cunningham 1996; Sternberg 1998). Thereby, in order to promote the practice of PBL in course design, delivery, and iterative refinement, we should expect some appropriate IS support in doing curriculum action research in preparation for writing experience reports after conducting PBL style of teaching.

The Centre's Workgroups Context

It is believed that PBL can be facilitated by making classrooms into communities of learning where students work together toward common goals – the solution of a problem. The tasks involved in transforming a class of students into communities of learners, include – on the teacher's part – creating a positive atmosphere of learning where knowledge gaps and mistakes can be viewed in a positive way such as another opportunity to learn, directing students in productive group work, monitoring those groups, and facilitating inquiry through continual questioning and reflecting activities. In the process, the PBL students' active inquiry should be guided by some systemic efforts with the following characteristics. First, the learner should be involved in an authentic experience that genuinely interests him or her. Second, within this experience, the learner should encounter some genuine problem that stimulates thinking. Third, in solving the problem, the learner must acquire information, form possible, tentative solutions that may solve the problem. Fourth, the learner must test these solutions by applying them to the problem. Indeed, application itself helps the learner validate his or her own knowledge. To help the instructor with the PBL style of teaching, the Centre could institutionalize a number of workgroups to produce appropriate IS support in developing students' group-based problem solving.

Virtual Organizing IS Support for the *Centre* Operations

The idea of *virtual organizing*, attributed to (Venkatraman and Henderson, 1998), can be considered as a method of operationalizing a learning organization, dynamically assembling and disassembling nodes on a network of people or groups of people, to meet the demands of a particular organizational context. There are two main assertions associated with virtual organizing. First, virtual organization should not be considered as a distinct structure such as a network organization in an extreme and far-reaching form (Jagers, Jansen, and Steenbakkers, 1998), but virtuality is a strategic characteristic applicable to every organization. Second, information technology (IT) is a powerful enabler of the critical requirements for effective virtual organizing. In practice, virtual organizing helps emphasize the ongoing process nature of the organization, and it presents a framework of achieving virtuality in terms of three distinct yet interdependent vectors: virtual encounter for organization-wide interactions, virtual sourcing for asset configuration, and virtual expertise for knowledge leverage. The first deals with the new challenges and opportunities for interacting with the organization. The second focuses on the organization's requirements to be virtually integrated in a network of interdependent partners, so as to manage a dynamic portfolio of relationships to assemble and coordinate the necessary assets for delivering value to customers. The third is concerned with the opportunities for leveraging diverse sources of expertise within and across organizational boundaries to become drivers of value creation and organizational effectiveness. All these three vectors are accomplished by the provision of suitable Web-enabled applications, whose ongoing design represents the IS challenge of every organization in the Internet age. From an organizational viewpoint, the respective roles of teacher and students are considered as the clients of the Centre. Both teachers and students are to use the services provided, and are being supported in carrying out their academic activities according to the PBL style of teaching and learning. In the following discussion, we are to examine how the three vectors could respectively fit into the Centre's context of providing IS support for the PBL initiative.

Applying Virtual Encounter to Teacher-Student Interaction

It is envisioned that in a specific course context, the interactions among students, and between the instructor and students, enabled through the Centre's services, will be offered in a customizable way. First, there should be an organizational space for the course, $\boldsymbol{OS}_{\mathbf{Course}}$, to start with. Second, in the course space, there should also be a number of collaborative spaces,

CS_{PBL}, to enable group-based project work to be performed by PBL students. Third, each student or teacher will be given a personal space, $PS_{Individual}$ ($PS_{Teacher}$ **or** $PS_{Student}$), to facilitate individual work performance. The linkages from the course space, to the respective collaborative spaces, to the individual personal spaces, must be closely constructed to facilitate the Web-based auxiliary experience of the teaching and learning processes. The challenge is to ensure that the sites should complement the course delivery by enabling both teacher and students to interact asynchronously or synchronously through the different customizable services offered. The simple expression for this vector is written as follows: $\textbf{<IS-Support>}_{Course} ::= OS_{Course} + \{ CS_{PBL} \} + \{ PS_{Student} \} + PS_{Teacher}$. It should be noted that the community of student learners made up of different PBL groups, is expected to form some virtual community of learners through the provision of the collaborative spaces in the course space.

Applying Virtual Sourcing to Intellectual Asset Configuration

From the Centre's viewpoint, a course itself represents a specific configuration of intellectual assets. In addition to the instructor's and the students' contributions during the course, a particular course is assembled from a variety of intellectual components, including the course goals, course content, course activities, course resources, course assessment, course delivery, course in-class organization, and course retrospection. The question of sourcing such components for each course joining the PBL initiative is an ongoing intellectual activity itself. It is believed that this sourcing activity should best be done through the idea of modularity, whose value-adding role lies not so much on the manufacture of a critical component as in the creation of a product or service architecture. Namely, while controlling the architecture of the course itself, the Centre may obtain from outside the specific course component(s) in helping the instructor assemble the essential course ingredients to deliver a superior PBL learning experience. The implication from this sourcing practice is that we must establish a portfolio of capabilities and relationships the Centre could make use of in understanding where or from whom we can obtain such intellectual components. Obviously, the Centre must be part of a vibrant, dynamic network of complimentary capabilities, be it within the scope of the Department, the Faculty, the University, the network of partnering universities, or the brokerages of educational services.

Applying Virtual Expertise to Knowledge Leverage

One of the emphases in PBL teaching is that we learn by dealing with others, exchanging ideas and comparing our ideas with other people. Besides, PBL emphasizes the importance of students' active participation in authentic learning tasks. Yet, we learn best when working alongside someone who is already good at the tasks. This is the essence of apprentice-like learning. In fact, the design of PBL lessons must involve students in some form of cognitive apprenticeship in which students learn by doing alongside the teacher but also learn why they are performing something in a certain way. Meanwhile, we want our students to understand the process of problem solving and become better self-directed learners. One of our PBL learning experiences is to enable knowledge development and transfer among teachers and students in an interactive and collaborative atmosphere. Students actively participate in generating, accessing, and organizing the required information for problem identification. They construct knowledge by formulating their ideas into words and then develop these ideas as they react to other students' or teachers' responses to their formulations. Knowledge construction can then be considered as the process of progressive problem solving, which encourages students to be innovative, create intellectual property, and develop and acquire expertise. To achieve these knowledge tasks, our academic staffs need considerable skill and knowledge to deal with the acquisition, creation, packaging and application of emergent knowledge. Often, we might need help from the wider community of professional expertise well beyond the domain of a local organization. The suitable design of this vector thus represents a tremendous challenge in knowledge leverage.

The Root Concept of PBL Support for Knowledge Synthesis

To learner-centered teachers, part of good instruction means to encourage self-direction and learner-control in their students. The salient aspects underlying our root concept of PBL course support can be understood in several directions.

Enable students to determine what they need to learn through questioning and goal setting

It is believed that students should work to identify their knowledge and skill deficits, and to develop strategies in the form of personal learning goals for meeting those deficits. The emphasis is to foster a sense of students' ownership in the learning process. If teachers, through the Web-based support environment, can guide the students in identifying what they already know and what they need to learn, then knowledge gaps and mistakes can be viewed in a positive way such as another opportunity to learn. And students can assume more responsibility in addressing their own learning needs during any instructional unit.

Enable students to manage their own learning activities

It is believed that students should be enabled to develop their learning plans, which should describe priorities, instructional tactics, resources, deadlines, roles in collaborative learning situations, and proposed learning outcomes, including presentation and dissemination of new knowledge and skills, if applicable. Traditionally, these instructional events are arranged by teachers to be obeyed by students, in order to accomplish a specified set of pre-determined objectives. Yet, it is not advantageous for students to learn to be self-directed. To manage their own learning activities, students must be guided and supported by the teacher, through the Web-based environment, slowly taking on more and more responsibility of their own learning.

Enable students to contribute to one another's learning through collaborative activities

It is believed that students should be encouraged and supported to discuss and share their personal findings. Particularly, we should enable students to become co-builders of the course/learning resources through evaluating and refining the entries their peers put into the Web-based depository. Collaborative group-based learning seems appealing to achieve the purpose. Students, nevertheless, must be educated to recognize what they are trying to learn in group-work, value it, and wish to share that value with others. Teachers can provide this sense of accountability and belonging by structuring students' work in the support environment with more innovative and pragmatic pedagogical devices.

The Contributions of the Learning Organization Model of PBL

What makes the PBL approach work, is people's mutual understanding of their own and others' interests and purposes, and the recognition that their interests are somehow bound up in doing something to which they all contribute. When a group of people, over time, has learned to enhance their capacity to create what they truly desire to create, this is an instance of a learning organization. Looking more closely at the teamwork development, we often see people being changed, somewhat profoundly. There is a deep learning cycle. Team members develop new skills and capabilities, which alter what they can do and understand. As new capabilities develop, so too do new awareness and sensibilities. Over time as people start to see and experience the world differently, new beliefs and assumptions begin to form, which enables further development of skills and capabilities. This deep learning cycle constitutes the essence of the learning organization ideal – the development not just of new capacities, but also of fundamental shifts of mind, individually and collectively (Senge, Roberts, Ross, Smith, and Kleiner, 1994). Today, an organization's ability to learn is often considered as a process of leveraging the collective individual learning of an organization to produce a higher-level organization-wide intellectual asset. This is a continuous process of creating, acquiring, and transferring knowledge accompanied by a modification of behaviour to reflect new knowledge and insight, and to produce a higher-level organizational asset. Conspicuously missing, however, is often a discussion of collaboration (Schrage, 1990) as a regenerative source of ideas that will advance the organization to learn, change, and excel. Garvin (1993) characterizes organizational learning as a continual search for new ideas. To collaborate through the *Centre for PBL Research* is to work in a joint intellectual effort, to partition problem solving to produce a synergy such that the performance of the whole exceeds that of any individual contributor. The central issue in the learning organization model is how individual learning is transferred to the organizational level. Here, we are assuming an organization of learners who take ownership for their development and learning on a self-directed basis. Yet, only with a clear understanding of the basic learning disciplines (personal mastery, mental models, shared vision, team learning, and systems thinking) can we manage the learning processes consistent with organizational goals, issues and values. Personal mastery is learning to expand our personal capacity to create the results we most desire, and it is about creating an organizational environment which encourages all its members to develop themselves toward the goals and purposes they choose. Mental models include the reflecting upon, continually clarifying, and improving our internal pictures of the world, and seeing how they shape our actions and decisions. Shared vision is concerned with building a sense of commitment in a group, by developing shared images of the future we seek to create, and the principles and guiding practices by which we hope to get there. Team learning is about transforming conversational and collective thinking skills, so that groups of people can reliably develop intelligence and ability greater than the sum of individual members' talents. Systems-thinking is concerned with cultivating a way of thinking about, and a language for describing and understanding, the forces and inter-relationships that shape the behaviour of systems. This discipline helps us see how to change systems more effectively, and to act more in tune with the larger processes of the external world.

The Vision for the Virtual University

With the rapid advances in networking technologies and the commercialization of the Internet today, universities are well poised to enhance their delivery of educational services. But, this vision often requires establishing an electronic

infrastructure within the physical university, to take advantage of the new technologies and opportunities. We call this the virtual university (VU) (Chellappa, Barua, and Whinston, 1997), an electronic entity constructed to enable a re-engineered vision of a university's educational process. The first challenge for the VU educators is to figure out how to harness the power of the new media to take advantage of its capacity to support flexibility, concurrency, and just-in-time design, instead of merely using the new media to deliver the same old stuff. There have been two positions of managing education through the VU (Bates, 1995; Berreman, 1997): the linear and the dynamic ones. In the linear model of education, learning design proceeded in a linear fashion from defining objectives to lesson planning to course delivery. Educators first engaged in a comprehensive learning needs analysis process, often based on assessments done by others about competencies and learning objectives. Comprehensive course syllabi were developed. Finally, the course was delivered as planned. Associated with this linear approach were a set of teaching strategies which matched its linear qualities, characterized by being predominantly one-way, centralized, and broadcast-oriented. When students appeared bored and unengaged in this type of program, the solution was to find ways to use new media to make the one-way broadcast more entertaining. Much early online learning was nothing more than a way to generate a broadcast of an expert and his multi-media slides with good production values. The VU model was praised because of its ability to scale up to reach larger numbers of students at standardized levels of quality. However, an expert lecturing to a group of passive students is engaging in didactic one-way teaching no matter how that lecture is delivered, say from a stage in an auditorium, or via broadcast videos to students sitting in front of their workstations. Today, we need a renewed mindset for education. Teaching and learning is currently seen as an ongoing process rather than a program with a fixed starting and ending point. The importance of widespread participation by learners in the design of their own learning has been widely recognized (Kimball, 1995). ICT (information and communications technologies) are particularly well suited to a more dynamic approach to managing education. Good teachers have always been open to changing their lesson plans based on student input. New media makes it easier. And online environments can provide space for continuing conversation among students and teachers about what is working and what is not working in the course. The idea of participatory course design is not to be neglected. The VU environment provides an opportunity to support collaborative learning in ways we have not been able to do before. Yet, just putting participants together in some kind of common electronic space will not turn them into a collaborative group automatically. The key is to design a framework for group work, which requires the team to grapple with roles, protocols for working interdependently, and mutual accountability. The answer suggested in this paper is PBL according to the learning organization model. Nevertheless, how can we help faculty make the shifts in thinking required to be effective in the VU courses? What is the best way to learn to manage these new aspects of the learning process? This question is being answered by our deliberation of the idea behind the *Centre for PBL Research* in our Faculty.

Remarks for Continuing Challenges

As Peter Senge (1990) says, "The organizations that will truly excel in the future will be the organizations that discover how to tap people's commitment and capacity to learn at all levels in an organization." To harvest the knowledge and experience of people and make it available to the organization as a whole, ICT needs to be managed differently to support dialogue rather than mere databases. In this information age, education and training in organizations, particularly the VU, consist of large amounts of explicit knowledge made available through huge archival databases. Nonetheless, today's knowledge or learning organizations create environments where experiential knowledge is learned through dialogue and interaction day-to-day. Communication technologies are needed to support this interaction. The learning environment should stimulate and nurture the complex network of interpersonal relationships and interactions, which are part of an effective communications and decision-making process. People must be allowed to make choices about whom they need to communicate and learn with without regard to traditional organizational boundaries, distance and time. In other words, they need to manage their own learning to form new groups and teams as requirements develop and change. The new framework for managing the VU should be about managing the learning process as well as managing course contents. The kinds of questions we need be asking ourselves are not only about how to plug one type of technology into another, but also about how to use technology to leverage resources and group dynamics in new ways to make fundamental changes in every part of the learning process.

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