Nurturing Self-Directed Work Teams in the Education of Information Systems Professionals

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Abstract

This paper investigates the context of self-directed work teams (SDWT) in the education of information systems (IS) professionals, underlining the essence of human aspects in the process of IS design and construction. The investigation elaborates on the SDWT context from the perspective of problem-based learning (PBL). What this means for teaching and learning is often not a core subject curriculum so much as core characteristics, qualities and kinds of outcomes for all who experience IS education. The discussion on the capability of self-directed learning, especially in team settings, and its challenge in higher education becomes important. The issue lies in the conceptual shift in thinking about our practice from delivering knowledge to fostering independence of learning in which students develop the ability to discover and reconstruct knowledge for themselves. Actually, this could be the core of a PBL-based approach in IS education: an understanding of one's own knowledge needs, application of knowledge to novel problem situations, collaboration, and lifelong learning. The nurturing of self-directed work teams of IS professionals in the academic setting, therefore, deals with two essential entities that are vital to the operation of a professional curriculum: group collaboration and self-directed learning. Together, they provide substance for the social and psychological dimensions of the learning interactions embedded in the curricular imperative that is a sophisticated design requiring attention to learner and to teacher, to content and to context.

Keywords: Problem-based learning, self-directed learning, group collaboration

Introduction

Today, higher education is expected to deliver to society individuals (HEQC, 1996) who have developed both a range of transferable key skills and the more general ability and willingness to 'learn to learn.' The former, typically comprising skills in communications, teamwork, problem solving, and information technology, enables the graduates to seek employment in a variety of service settings. The latter, representing the core skill of the transferable skills enumerated, characterizes the individual's ability to continue to learn new knowledge, skills and practices. Indeed, each year, the National Association of Colleges and Employers in the States conducts a survey to determine what qualities employers consider most important in applicants seeking employment (NACE, 2003). In 2003, among the top ten factors listed on a five-point scale, with five being "extremely important" and one being "not important" included the following six most desired characteristics: Communication skills (4.7 average), honesty/integrity (4.7), teamwork skills (4.6), interpersonal skills (4.5), motivation and initiative (4.5), strong work ethic (4.5), while the rest remain analytical skills, flexibility/adaptability, computer skills, and self-confidence.

In fact, the dual challenges of society's critical dependence on the quality and cost of computer-based IS support, and the relative immaturity of software development, make attention to professional practice issues in IS development even more important. It is expected that graduates of IS programs need to arrive in the workplace equipped to meet these challenges and to help evolve the IS development practice into a more professional and accepted state. It is thus useful to review the nature of the teacher-student encounter in higher education (Light, 2000; Cox, 1987; Barnett, 1997, 2000; Barnett & Hallam, 1999; Kember, 1997) in which students need to recognize that their education in school can provide a learning experience that enables them to stand up for what is professionally appropriate. In light of this, by laying a lifelong framework of learning from group-based project work as part of the IS program, students can avoid the sense of isolation that young professionals often feel and be equipped to practice their profession in a mature and ethical way. In this regard, the discussion of Kember's five different conceptions provides an important lever into understanding the basis of self-directed work teams in the context of IS development, especially in relation to the pedagogical insights of problem-based learning (PBL) (Vat, 2006, 2004) whose influenced has been so much emphasized in the final draft of the Computing Curriculum – Software Engineering (SE2004, pp. 41-45; http://sites.computer.org/ccse/SE2004Volume.pdf) released by the Joint Task Force on Computing Curricula of the IEEE Computer Society and the Association for Computing Machinery.

The Teacher-Centered/Content-Oriented Conceptions

In the first conception, the teacher regards the practice of teaching as one in which he or she imparts or transmits information to the student. The teacher as presenter is a transmitter and the student a passive recipient or receiver. Teaching mainly rests in the content of the curriculum and quality of the knowledge that the teacher possesses and controls. In this content-oriented conception, good teaching consists of having sound academic knowledge. Meanwhile, teachers holding the second conception still regard teaching as the transmission of information between a presenter possessing knowledge and a recipient, but recognize that the teacher can more effectively order and structure the curriculum and the information transmitted.

The Transitory Conception

The third conception is a transition conception between substantially different ways of understanding teaching. It is often associated with notable development in the understanding of teaching practice. It is characterized by change, particularly with respect to the perceptions of the teacher and the student. The teacher regards the student as a participant in a shared situation in which the teacher is presenting but also tutoring. The situation is not now simply a void across which content and knowledge is transmitted but rather they are seen as part of an interactive process. The teacher still defines and frames knowledge but the student is encouraged to discover it within the situation.

The Student-Centered/Learning-Oriented Conceptions

The fourth and the fifth conceptions of teaching describe a qualitatively distinct orientation in which the student becomes the center of focus. Improving their learning becomes the focus of teaching, but not simply as the accretion of knowledge presented to them. Content and knowledge occur as a result of student learning, and of the student constructing it for him or herself. In this situation, the teacher is a facilitator of this learning, having a responsibility to help students in their constructions of knowledge. The fifth conception of teaching extends the role and responsibility of the teacher beyond helping students' cognitive construction of knowledge. It also helps them develop and change their own conceptions of the subject and themselves as a person. It recognizes that knowledge is socially constructed.

Developing Self-Directed Learning

Based on our discussion developed earlier, problem-based learning (PBL) strategies share the following common characteristics (Eggen & Kauchak, 2001, p. 229): They all begin with a problem or question (Duffy & Cunningham, 1996; Grabinger, 1996). This problem or question serves as the focal point for student investigative efforts. Students assume primary responsibility for investigating problems and pursuing inquiry (Slavin, 1986, 1995; Slavin, et al., 1994). This responsibility is important because students in problem-based lessons literally learn by doing. The teacher's role in problem-based learning is primarily facilitative (Stepien & Gallagher, 1993). As opposed to more content-oriented models, in which the teacher actively disseminates information, problem-based learning requires teachers to assist more indirectly by posing problems or questions and asking helpful but probing questions.

Meanwhile, problem-based lessons typically have three interrelated goals. One is to develop students' understanding and ability to investigate a question or problem systematically. By participating in structured problem-based activities, students learn how to attack similar problems in a comprehensive and systematic manner. A second, but less prominent goal is content acquisition. Much of the content that students learn in problem-based lessons is implicit and incidental in the sense that neither the teacher nor students know exactly where the investigation will proceed. A third goal of PBL is the development of self-directed learning (SDL), which develops when students are aware of and take control of their learning progress. SDL is a form of meta-cognition (Brown, Bransford, Ferrara, & Campione, 1983; Brown & Campione, 1990), which involves knowing what we need to know, knowing what we know, knowing what we do not know, and devising strategies to bridge these gaps. These abilities help people to grow intellectually by adapting and applying knowledge to new situations, as well as by recognizing the need to move beyond one's current knowledge state to a new level of understanding. Indeed, learning experiences which support the development of SDL skills are important in enabling the practicing IS developer to be a lifelong learner and a competent problem solver.

There are many ways to scaffold students' SDL abilities. One way is to provide students with opportunities to learn specific knowledge and skills in the context of solving complex problems. This is the essence of problem-based learning (Barrows, 1985). Indeed, because the problems used are complex, students often work in groups, where they pool their expertise and experience and together grapple with the complexities of the issues that must be considered. As they work through the problems, they have opportunities to identify gaps in their knowledge and then set their learning goals and conduct research to reduce these gaps. Facilitators guide students' reflection on these experiences, facilitating learning of the cognitive and social skills needed for problem solving and for SDL. Because of the discovery nature of learning in PBL, skills needed for SDL are acquired as students manage their learning goals while coping with the problems they are trying to solve. In light of this, there are several features of PBL that specifically support the development of SDL skills: *The learner should be involved in an authentic experience that genuinely interests him or her. Within this experience, the learner should encounter a genuine problem that stimulates thinking. In solving the problem, the learner acquires information. The learner forms possible, tentative solutions that may solve the problem. The learner tests these solutions by applying them to the problem. Such application helps the learner validate his or her own knowledge.*

Understanding the Student-Centeredness of PBL

In traditional curricula, the teacher determines the type and sequence of information to be learned by the students. In the PBL curricula, learning was student-centered with faculty facilitation, meaning that the students took much of the responsibility for their own learning. This was accomplished through careful design and sequencing of problems and through encouraging faculty in facilitative skills (Barrows, 1986). The instructor, playing the facilitator, performs the role of a coach by modeling and scaffolding the kinds of self-assessment questions that the students need to ask by themselves to become self-directed learners. Using questions such as "What do you specifically hope to learn or find out?" or "What more do you need to know before you can make a decision?" to facilitate student learning in PBL helps gradually transfer the agency of assessment to students. Eventually, the students internalize these questions and pose them to themselves in a meta-cognitive fashion (Collins, Brown, & Newman, 1989). This enables them to go further in self-assessment and understand themselves on their lifelong journey of learning and knowledge building (Bereiter & Scardamalia, 1989).

Formulating and Researching Learning Issues

In the midst of the PBL process, as students try to use their existing knowledge to solve a problem, they identify their knowledge deficiencies as learning issues. Generating such learning issues gives the students experience with setting their own learning goals relative to the problem being faced. This enables students to develop the skills and goal orientations that they need to be mindful as self-directed learners (Bereiter & Scardamalia, 1989). Meanwhile, with the learning issues divided among students to pursue their independent research to solve the problem at hand, they become proficient in locating appropriate information resources and posing timely questions to one another when necessary. Students typically construct conceptual knowledge and procedures for solving various problems. The underlying process often prepares PBL students to become flexible and adaptive learners who can use their expertise in learning in a range of novel situations (Hatano & Inagaki, 1992).

Collaborating and Contextualizing Knowledge for Problem Research

As part of the independent research effort in problem solving, students need to critically evaluate the resources they have used. They need to consider the reliability of the resources and how these resources contribute to knowledge construction. They have to distinguish what is relevant from what is not, and learn how knowledge can be used as a tool in further investigation. According to numerous studies conducted by Bransford and colleagues, students who learn in ways that facilitates an understanding of the relevance of information are more likely to develop working knowledge structures that connect isolated pieces of information. Building such knowledge will facilitate access when relevant problems arise (Bransford, Sherwood, Vye, & Rieser, 1986). Besides, it is understood that collaboration is an important learning tool that scaffolds students' inquiry in PBL settings. Students, collaborating, often reflect on the usefulness of the knowledge they construct as a result of their SDL and on the processes in which they engage to achieve their learning goals. In fact, reflection through collaboration is a critical component of the SDL process if students are to transfer their strategies and knowledge to new situations (Salomon & Perkins, 1989). Different types of reflection will lead to different types of learning and transfer. Reflecting on the PBL process will help students identify what they need to understand, build connections between the procedures and concepts, and identify the causal mechanisms underlying a wide range of problems (Berardi-Coletta, Buyer, Dominowski, & Rellinger, 1995). More importantly, the collaborative discussions in the PBL group enhance reflection as students share and compare their thinking with others in the group.

Developing Group Collaboration

To discuss the PBL context for group collaboration, the PBL group model as described by Barrows (1988) becomes insightful and useful, in which the PBL tutorial group is central to the PBL cycle of collaboration. The ideal tutorial group, according to Barrows, consists of five to seven students and a group facilitator commonly referred to as a tutor. The group meets to address problems that form the core of the PBL activities. In the ideal implementation of PBL, these problems are actual, real-world problems, unfolding just as they do in the real world. Oftentimes, the word 'problem' used in the PBL context could refer to any situation that inspires a goal for which there is no clear path to reach it. Hence, the PBL problems could engender multiple hypotheses and require the application of knowledge and skills for their resolution.

In particular, PBL students must be trained to approach the problem as a collaborative team, generating hypotheses and inquiring against them using appropriate strategies and sources. As they work through the PBL process, group members, aided by the tutor's strategic probing, note the knowledge and skills that the problem demands, assess their own competency with respect to these, and identify as learning issues that about which they need to learn more. The PBL group plans and implements any necessary procedures to acquire the needed knowledge and skills. Namely, each member is committed to develop the functional expertise in one or more of the learning issues.

After a period of self-directed learning, PBL group members return to the problem armed with their increased competency in the knowledge and skills afforded by the problem. Subsequently, this process continues until the problem is resolved and explained, with decisions justified based on the underlying rationales and mechanisms. As the resolution of each problem is settled, the group reflects on its work, both collectively and individually. Each member provides an assessment of his or her work and is likewise assessed by peers and the tutor with respect to some preset criteria of PBL performance, such as excellence in knowledge, in problem solving, in self-directed learning, and in collaboration.

PBL Groups as Collaborative Learners

The term *collaborative learning* suggests a wide variety of definitions (Koschmann, Kelson, Feltovich, & Barrows, 1996). Yet, for discussion sake, it is hereby used to refer to the process by which individuals, working from differing perspectives, come to an understanding of rich, complex concepts. In particular, this is based on cognitive flexibility theory (Spiro, Vispoel, Schmitz, Samarapungavan, & Boerger, 1987), where it is argued (Feltovich, Spiro, Coulson, & Feltovich, 1996) that collaborative learning environments provide the multiple perspectives that enable the acquisition of complex concepts and the avoidance of overly simplistic reductions that characterize novice understanding. Roschelle (1996) put forward a similar argument. Addressing findings that document the unusually strong tendencies of students to construct rich meanings for scientific concepts (Confey, 1990; Eylon & Linn, 1988; McDermott, 1984), Roschelle argued that students working collaboratively are able to construct increasingly sophisticated approximations of scientific concepts through the process of gradual refinement of ambiguous, figurative, and partial meanings. He proposed that through an iterative cycle of displaying, confirming, and repairing shared meanings, students collaborating in learning can move from idiosyncratic commonsense notions about the meanings of concepts to meanings and understandings shared by the scientific community. In order to develop a PBL group of students into collaborative learners, it is important to consider the inter-relationship between the PBL problem and students' responsibility for collaborative learning advocated in a PBL curriculum.

PBL Groups as Collaborative Supporters of Individual Development

The development of the individual within the group is an important concern for the teacher-designer in the PBL curriculum. Though the learning experiences and problem solving are largely situated within the group, PBL students are expected to develop individually as learners and as problem solvers. The group can facilitate this growth if each individual assumes mutual responsibility for the others' excellence. According to the Barrows (1988) group model, each problem ends with a period of reflection on individual performance. Each member provides an assessment of his or her work with respect to each outcome of the curriculum such as basic knowledge acquired, problem solving attempted, self-directed learning experienced, and collaboration deepened. This is followed by input from every other student member in the group as well as from the tutor. Following Barrows' recommendations, I have formalized this procedure to take place at least three times throughout a semester, at the end of each milestone of project development, providing data that count for student progress. In my experience, the self-based and peer-based assessment process can be a powerful agent in developing outcomes in individuals. Students are advised to cite specific evidence for evaluative statements both in their self-assessment and in the assessment of their peers. They are encouraged to state goals for future improvement and the group is encouraged to enter into planning for reaching these goals as well as for monitoring progress toward them. It is important that every student in the group is entitled to this level of formative assessment. If any of the students has a problem, it becomes the group's problem. This climate of mutual support enables students to be precise and honest both in their self-assessment and in their assessments of others in the group. Furthermore, when tutor assessment is brought into the group process, these judgments, along with the criteria for making them and the evidence cited to support them, belong to the common pool. All students profit from each other's assessment. Importantly, if group members do not identify issues in members that the tutor recognizes, it is the tutor's responsibility to address them in the group context. But, the group is ultimately responsible for its own climate and functioning. The tutor, as the facilitator of the process, must stimulate the kind of group reflection that allows this to happen.

A Teacher-Researcher's Remarks on the Challenge for SDWT

In nurturing self-directed work teams (SDWT) for IS development, it has been observed that our PBL students have experienced difficulties in teamwork throughout the project period. Their reported details include setting realistic project/team goals, carefully allocating tasks to team members, managing time, and communicating and managing shared documents. In the regular meetings to which the author had been invited to observe their working, however, they have demonstrated their abilities to set appropriate agendas before meeting, assign suitable time to the agenda items during meetings, restate the decisions made at the meeting for actions afterward. Yet, they also confess that PBL learning experiences indeed exert high cognitive demands on learners, to which the author agrees. It is important that PBL students are taught how to work in teams and positively experience the team process because the team skills they obtain are applicable throughout their future careers.

However, it is not easy to provide a holistic vision of management for IS development in a single course of experimentation. Often our PBL teams have to play the roles of IS professionals achieving that milestone of transitioning from individual contributor (software design and implementation) to a member of management. I have to confess that this is indeed a big challenge. There are always new ideas or skills for the teams to acquire in order to solve problems. Team building is thus an iterative process that requires the author's constant attention throughout the lifecycle of a well-conceived design scenario (a real challenge in itself), especially when team members have to be considered for their uniqueness and individuality.

Meanwhile, it has been learned that PBL students indeed use their training to enrich their performance; they articulate their newly constructed ideas and through argument and persuasion, build shared meaning. This is something not often seen in the traditional format of teacher-centered, subject-based learning, with the dominant mode being courses of lectures. Moreover, it is convinced that the context of the learning scenario, provides a basis for students' later transference, and learning is accomplished by reflection as an important meta-cognitive exercise. Also, the group nature reflects the constructivist focus on the value of negotiated meaning. Nevertheless, teaching, directing and managing the PBL group project work has not been easy for understandable reasons: expensive, and complex. "Expensive" means demanding considerable supervision and technical resources; "Complex" means combining design, human communication, and technology to satisfy the objectives ranging from consolidation of technical skills through provoking insight into organizational practice, teamwork and professional issues, to inculcating academic discipline and presentation skills. Yet, this constructivist method does enable students to be active learners, initiating their journey of being IS professionals.

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