Reflections on a Course in Emerging Information Technologies

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Abstract

The purpose of this paper is to serve as a departure point for a discussion on the design of a course in Advanced Information Technologies, with a special emphasis upon providing students with the tools to identify new, emerging technologies. The paper also shares the experience of offering such a course to graduate students in Information Systems during the Spring of 1999, the Spring of 2001, and the Spring of 2002.

The course was designed to engage the students in participatory learning exercises in order to give them experience differentiating emerging from simply new information technologies, using principles described early in the course.

Keywords: Emerging Technology, Adult Education, CIO, Certification, participatory learning

Philosophical Assumptions

The course stems from the assumption that Information Systems (IS) is a young, dynamically changing field. IS has borrowed freely from several other disciplines, including mathematics, computer science, cybernetics, economics, and psychology. Since its inception, the discipline has existed most notably in a relationship with Information Technology (IT), which encompasses computer hardware, software, and telecommunications technology. Although this relationship has been to some degree symbiotic, its nature has most often been that changes in IT have enabled subsequent changes in IS. The relationship is so close that some practitioners are not even aware of the difference.

The result of this implicit, eclectic philosophical approach driven by a powerful enabling technology with validation through the marketplace has been a discipline continually beset by fads, each one of which in its time is proclaimed to be the latest paradigm shift, in the spirit of Thomas Kuhn. The difficulty is that the discipline has, in fact, had more than its share of genuine paradigm shifts, beginning with the shift from a batch, data processing model to an interactive, Management Information Systems (MIS) model, from a centralized, mainframe-oriented model to a decentralized, client-server model, and now to an integrated, component-based, network-oriented model. These shifts also parallel closely the changes in organizational structures from the centralized, command and control structures of the early period, through more decentralized, department-level models, to a still-emerging inter-organizational network model.

The course objective, therefore, is to acquaint students with theoretical perspectives through which they can discern truly emerging technologies from those that are simply new and to give students the opportunity to apply these theories to currently new technologies through class presentations by industry representatives and through independent re-

search conducted by students, both individually and in groups.

Background

Participation in U.S. adult education activities has increased significantly for at least the past ten years. The U.S. Department of Education (DOE) reports increases over the period of 1991 to 1999 in virtually every group of adults they follow (Creighton & Hudson, 2002). More specifically, DOE reports adult education participation patterns increasing in all age groups, except ages 35-44 (which held constant), for all racial groups, all education levels, all labor force statuses, and all occupational groupings. In this context, DOE notes that participation in credential-granting programs grew most rapidly during this time period among those with more education, those in the labor force, those in professional and managerial occupations, and those with continuing education requirements.

Enrollment in George Washington University's (GWU) Master of Science in Information Systems (MSIS) and Master of Science in Information Systems Technology (MSIST) programs from 1997 to 2001 reflects this trend only in part, largely due to higher admission standards, with enrollment in 1997 of 434 falling to 388 in 2001. Graduation rates during this period improved, however, with 119 graduates in 1997 increasing to 178 in 2001 (GWU, 2002).

It was during this latter period that GWU began to offer an off-campus course in emerging information technologies, with 22 students in 1999 (eleven male and eleven female, all employed full-time), 11 students in 2001 (nine male, two female, all employed full-time), and 30 students in 2002 (21 male, nine female; two enrollees were full-time students). In 2000, GWU was chosen by the U.S. General Services Administration to offer a Chief Information Officer (CIO) certificate in conjunction with the already existing GWU Master of Science degree. The CIO certification program requirements consist of the required Master of Science requirements, along with a course in Information Resource Management and the course in emerging information technologies. This certification program became known to students in mid 2001, and accounts for the increase in 2002 enrollment over 2001.

Educational Approach

The educational approach, one of participatory learning, is based loosely upon the theories of John Dewey, Malcolm Knowles, and David Kolb (Dewey, 1916, 1938; Knowles, 1980; Kolb, 1984). All three of these theorists stress the importance of integrating experience with theory and of the view of education as a continuing process, rather than the pursuit of some predetermined, teacher-defined outcome, with both Knowles and Kolb drawing heavily upon Dewey's work.

Knowles contrasts "pedagogy" with "andragogy". Pedagogy has been traditionally defined as the teaching of children or defined as a synonym for teaching methods, but Knowles defines it as "teacher-centered learning". Knowles contrasts this with "andragogy", traditionally defined as adult learning, but which he defines as "learner-centered learning" (Knowles, et. al. 2001).

Knowles identifies five issues that define "andragogic learning". Four of these issues are presented from the teacher's perspective: 1. Identifying why something is important to learn. 2. Teaching students how to navigate through available information. 3. Relating the topic to the student's experience. 4. Helping students overcome inhibitions and previous beliefs about the process of learning. One of these issues is presented from the student's perspective: people will not learn until they are motivated and ready to learn (Knowles, et.al, 2001).

Knowles's theory of andragogy can be used as a foundation upon which to elaborate a teaching approach based upon David Kolb's theory of experiential learning. Drawing primarily upon the theories of Dewey, Kurt Lewin, and Jean Piaget, Kolb describes a four-phase circular model of experiential learning. Kolb

begins with "Concrete Experience", which leads to "Reflective Observation". Reflective Observation leads to the formation of abstract concepts, a process that Kolb labels "Abstract Conceptualization". Abstract Conceptualization, in turn, leads to the testing of these concepts in new situations, a process Kolb calls "Active Experimentation" with the outcome of this testing leading back to Concrete Experience. The learner may enter this process at any point (Kolb, 1984).

Kolb notes that different individuals approach the learning process in different ways, with individuals orienting themselves more closely with one or more of the four phases. Out of this, Kolb identifies four broad learning styles with which individuals approach learning (Kolb, 1984).

Kolb describes individuals who focus upon active experimentation and abstract conceptualization as having a "Convergent" learning style. This style may be particularly appropriate for subject matter that is narrowly focused, has an orientation toward the practical application of ideas, and for which deductive reasoning is especially effective. A person with a "Divergent" learning style may be more comfortable with concrete experience and reflective observation. Such an approach may be effective for subjects where creativity and imaginative ability are important (Kolb, 1984).

Kolb describes a learning style that stresses abstract conceptualization and reflective observation one of "Assimilation". Assimilators may be particularly effective in learning subjects for which there is an emphasis upon the development of abstract models and the use of inductive reasoning. A learning style that stresses Concrete Experience and Active Experimentation is described by Kolb as "Accommodation". Such an approach is useful with subjects that stress "hands-on" experimentation and intuitive reasoning (Kolb, 1984).

Kolb notes that professional education presents a particular dilemma for engineers, in that individuals may have started their careers with tasks that emphasize a Convergent learning style, but as they move into a management role they may require the adoption of a different learning style for success (Kolb, 1984).

Many of the students enrolled in the Advanced Information Technologies course face this dilemma, since they are drawn from a population that has enrolled in the Master of Science in Information Technology course in order to make this transition. The dilemma is further accentuated in the Advanced Information Technologies course due to the tentative nature of the evaluation process for new technologies. The course is structured with this dilemma in mind, with a goal of moving the students through each of Kolb's learning styles.

Course Organization

The course is organized into four parts. The first part of the course uses Kevin Kelly's September, 1997 Wired article as a device to illustrate some of the kinds of questions and issues the discipline might address. Included in this part is a consideration of such topics as Moore's Law (chip density doubles every 18 months) and Metcalfe's Law (the power of a network is equal to the square of the number of its nodes). Students are also exposed to a brief introduction Coase's Theory of the Firm (Coase, 1988), and the implications of new IT systems for firm size. In its stress upon the abstract conceptualization and deductive reasoning of these theories, along with the observations of the Wired article, the course therefore begins with a Convergent learning style where it is assumed most students are beginning.

The second part of the course is concerned with establishing an epistemological foundation from which research can be conducted in Information Systems, and relies heavily upon the concepts of Donald T. Campbell's Evolutionary Epistemology (Campbell, 1974), upon Chaos and Complexity Theory, especially as applied to emerging markets by Deborah Spar (Spar, 2001), upon Michael Polanyi's definition of the concept of Emergence (Polanyi, 1966), and upon insights from Roger's Diffusion Theory (Rogers, 1995). In establishing this foundation, the approach moves toward a more assimilative learning style,

stressing abstract conceptualization, and, with the role of uncertainty in these theories, with a movement toward both abductive and inductive reasoning.

The third part of the course seeks to expose students to new technologies through presentations by IT industry representatives or practitioners. Care is made to avoid presentation by sales representatives in favor of actual practitioners. The 1999 course included presentations by a database developer on the use of semantic networks in databases searches, by an information systems professional on his experience in installing a Digital Subscriber Line (DSL) in his home, and by a representative of the National Science Foundation (NSF) on their experiences with telecommunications convergence, combining data with voice over the same telecommunications line.

The 2001 course included presentations on new business formation by a new, struggling .com, along with a contrasting view from a more established firm. Other presentations included a presentation by a web developer on web-based development techniques, by a handheld software developer describing challenges of developing graphical interfaces for PalmPilot-type devices, and by a healthcare industry software consultant on the implementation of new data interchange standards for the U.S. healthcare industry.

Presentations during 2002 have included a presentation by a legal scholar on the effect of copyright law upon web-based innovation, a presentation by a database vendor on tools for implementing XML standards for data dissemination, a presentation by an online service provider on the use of cell phones and other handheld devices over the Internet, and a presentation by a data mining vendor on new options for rapid access of large volumes of data. This represents a move toward an accommodative learning style, based upon concrete experience and active experimentation.

In the fourth part of the course, students lead the discussion of these topics in the session following the industry presentation. Students are also expected to produce a work of theoretical or practical research and to share their results with the class. This portion of the course stresses reflection upon the experiences from the third part of the course, and represents a Divergent learning style.

Student Feedback

Student reaction to all three courses has been uniformly positive. Students were especially appreciative of the opportunity to interact with industry representatives. Individual student research also opened up new areas of inquiry, most notably in the area of biometric systems. Student registration for the 2002 course reached capacity on the first day of online registration. Plans are now to offer the course each semester, in response to student demand.

Future Directions

Although student response has been positive, a number of questions remain regarding the future conduct of the course.

This course has deviated to some extent from previous courses in Emerging Technologies at GWU in that it seeks to expose the students to theoretical constructs that will allow them to differentiate merely new from truly emergent technologies. Previously, such courses were presented as merely “show and tell” of new technologies, or as brief descriptions of various technologies that had previously been identified as “emerging” by a Delphi process. Given this history, it is necessary to identify how effective this new approach has been, which raises the issue of how such effectiveness might be measured.

A confounding variable, in this regard, is that the course has been included as one of several required courses that students must take in order to receive a Chief Information Officer (CIO) certificate from the U.S. General Services Administration. Much of the demand for the course is most likely being generated

by students' desire to obtain this certificate. This leads therefore to the question of whether the skills taught in the course are skills that Chief Information Officers find valuable in their jobs.

Finally, it must be said that the theoretical constructs upon which the course is based may not necessarily be the most effective constructs upon which to base a methodology for identifying emerging Information Technologies. Much research and dialogue remains to be accomplished with regard to this issue.

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Biographies

J. Frederick Sencindiver, Ph.D., has extensive experience as an Information Systems developer and manager, supporting organizations in industry, as well as in the government and nonprofit sectors (1974-2000). He is currently an Assistant Professor of Information Systems at The George Washington University, Washington, D.C., and continues to consult with industry clients. Dr. Sencindiver holds a Ph.D. in Information Systems/Organizational Behavior and an M.S. in Information Systems from The George Washington University, and a BA in Psychology from Antioch College.

William H. Money, Ph.D. has significant management experience in the design, development, installation, and support of management information systems (1980-92). His publications over the last six years and recent research interests focus on collaborative solutions to complex business problems, business process engineering, information system development tools and methodologies including the WWW, Web workflow and expert systems; and the impacts of Group Support Systems (GSSs) on individual learning. He is also developing teaching and training techniques that prepare students to use GSS tools in complex organizations and dynamic work environments experiencing significant change. Dr. Money holds a Ph.D. in Organizational Behavior/Systems Engineering from Northwestern University, an MBA in Management from Indiana University, and a BA in Political Science from the University of Richmond.