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Integrating Three Theoretical Perspectives to Explain Internet-Based Technology Usage by University Students: A Qualitative Study

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INTEGRATING THREE THEORETICAL PERSPECTIVES TO EXPLAIN INTERNET-BASED TECHNOLOGY USAGE BY UNIVERSITY STUDENTS: A QUALITATIVE STUDY

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Abstract

This study explores how and why university students use Internet-based communication technologies. The study relies on qualitative data collected in the form of interviews, recording of actual postings, and student records over the period of one year (two semesters). The data are interpreted through three mutually complementary theoretical lenses, originally developed to understand adoption and usage processes of information technologies: Orlikowski and Robey's (1991) adaptation of Giddens' (1984) structuration theory, Markus' (1987) critical mass theory, and Fulk et al.'s (1987) social information processing model. Anticipated contributions include the development of guidelines and "intervention strategies" designed to help instructors encourage technology adoption and use for out-of-classroom communication, ideas to improve the technology's technical features, identification of criteria to assess the merits of Internet-based technologies for teaching purposes, and an extension and refinement of the theoretical frameworks informing this work.

1. INTRODUCTION

How the Internet is used to support teaching at the university level varies widely. In a recent survey of international IS faculty, Peffers and Bloom (1999) identified at least 13 different ways in which faculty employ the Internet as a teaching aid. Their list ranges from traditional applications such as e-mail-based instructor-student communication, through online syllabi and course material, to online chat rooms and multimedia lectures. While traditional applications were found to be adopted by more than half the survey respondents, more advanced technologies such as online chat rooms were only applied by a few.

Given the current trend followed by both private and public institutions to invest heavily in technology to enable Internet-based teaching (Applebome 1999; Herther 1997; Santosus 1998), Peffers and Bloom's findings can be expected to concern instructors, students, and academic institutions alike.

Although recent studies offer important insights about learning outcomes (Alavi 1994; Alavi et al. 1995; Webster 1997) and learning processes (Leidner and Jarvenpaa 1995), they do not explore processes driving student adoption and continued usage of these technologies. Yet, Peffers and Bloom's results imply that the instructors' lack of knowledge about adoption and usage processes keeps them from using Internet-based technologies (IBT) in their teaching in novel ways. In other words, a better understanding of IBT in general, and their appeal to students in particular, seems to be a prerequisite for their innovative and ground-breaking use as teaching tools.

The purpose of this study is to propose a rich and extensive model of university students' IBT adoption and usage. The study relies on qualitative data and follows a longitudinal design. The data are interpreted through three diverse, but mutually complementary, theoretical lenses originally developed to understand adoption and usage processes of information technologies.

The remainder of this paper is organized as follows. First, we introduce the theoretical lenses used to interpret our data. We then outline our methodological approach. Third, we discuss potential contributions as they apply to instructors, IBT-developers, academic institutions, and researchers.

2. THEORY

To achieve our research objectives, we study this phenomenon through the following theoretical lenses: Orlikowski and Robey's (1991) adaptation of Giddens' (1984) structuration theory, Markus' (1987) critical mass theory of interactive media, and Fulk et al.'s (1987, 1990; Schmitz and Fulk, 1991) social information processing model. As illustrated in Figure 1, we view structuration theory as a meta-theory. It constitutes our general framework linking institutional properties, IBT characteristics, and human agents (students, instructor) through four structurational processes. Furthermore, its recursive nature permits us to study the students' IBT usage and adoption over time, a property that other powerful and rich theories such as the theory of planned behavior (TPB) or the theory of reasoned action (TRA) essentially lack. We use critical mass theory and social information processing theory to refine the meta-theoretical framework by elaborating on the meaning of individual structurational constructs and processes.

Overall, the choice of the theories represents a tradeoff between our twin goals of drawing a fairly comprehensive picture of the students' IBT adoption and usage while trying to keep the underlying theoretical framework relatively parsimonious. In addition, all three of them have been used in the IS field before, and have proven their potential for producing valuable insights about IS adoption of usage behavior.

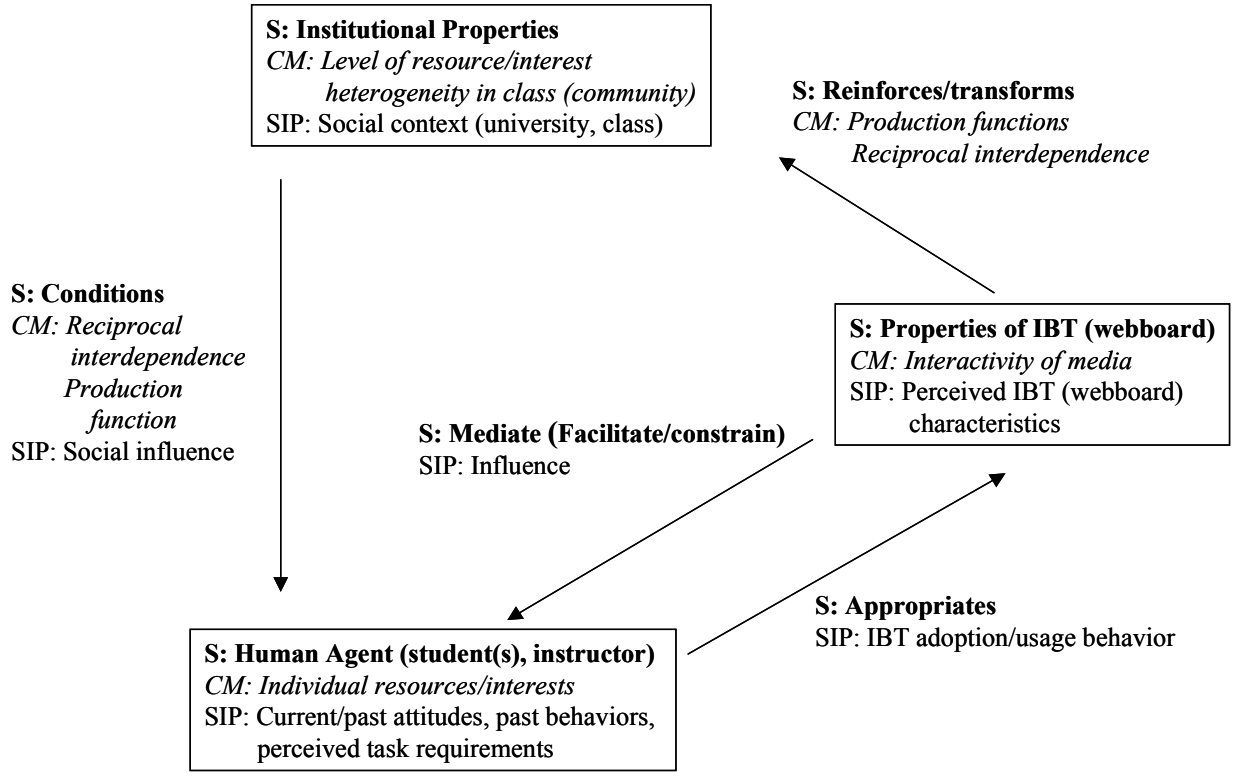

Figure 1. Integration of Theoretical Frameworks

2.1 Structuration Theory

Orlikowski and Robey (see also Orlikowski, 1992), adapted Giddens' structuration theory to explain how information technology (IT) and the institutional context where it is introduced interact. Reconciling the perspectives of technological and social determinism within one framework, the theory helps explore how IT affects the context it is used in and vice versa.

Following these ideas, we will study IBT usage behavior focusing on the relationship between a university's/class's institutional properties, student/instructor characteristics, and IBT characteristics. These three elements are linked via four structural processes reflecting four types of influence: (1) institutional properties condition, but do not determine, a student's media choice behavior; (2) depending on their features, IBT facilitate or constrain students in performing their work; (3) students appropriate the technology according to their individual interpretations of conditions prevalent in the institutional context and IBT's facilitating/constraining features; (4) depending on whether IBT usage works against or is supportive of established institutional conditions, it reinforces existing institutional properties or gradually transforms them.

2.2 Critical Mass Theory

This theory was first suggested by Oliver et al. (1985). Markus later applied it to the diffusion process of interactive (communication) media such as e-mail, FAX, and the telephone. Oliver et al.'s objective was to propose a theory capable of explaining the extent and effectiveness of group actions in creating a public good. They defined *critical mass* as a subgroup of a community that is motivated enough to make significant contributions toward the establishment of a public good. The combined contributions of this subgroup should be large enough to increase the value of the emergent public good so that other—less interested and/or less resourceful—members of the community are attracted to join in as well. Eventually all community members will have participated—more or less—in creating the public good. Applying these ideas to the diffusion process of interactive media, Markus deviated from Oliver et al.'s assumption of sequential dependence of community members' behavior and replaced it with the notion of *reciprocal interdependence.* While she agrees with Oliver et al. in that early adopters influence the adoption behavior of their less adventurous peers, she notes that in the special case of interactive media the opposite is also true: early adopters are influenced by the behavior of later adopters/non-adopters in deciding whether to continue or discontinue using a technology. Markus further suggested that there are only two stable states of universal access (the public good associated with the diffusion of interactive media): it's either "all or nothing." Whatever the final outcome, it will depend on two preconditions: the shape of the production function (i.e. ,the relationship between the contributed resources and the likelihood of collective action) and the level of heterogeneity of the community's resources and interests.

Since IBT are interactive media, critical mass theory is likely to provide us with valuable insights about the students' reciprocal interdependence in their webboard adoption and usage behavior.

2.3 Social Information Processing Model

Fulk and colleagues proposed a theoretical model focusing on the social influence processes affecting a person's attitudes toward communication media and his/her decision to adopt and use the technology (Fulk et al. 1990). The authors argued that media usage does not only depend on rational choices as suggested by media richness theory (Daft and Lengel 1984), but also on information embedded in the social context. To integrate the latter with the former, Fulk and colleagues drew on Salancik and Pfeffer's (1977, 1978) social information processing model, which posits that a person's attitudes and behaviors are partly socially constructed.

According to Fulk et al. (1987), a person's media choice behavior is driven by his/her perceptions of how well communication task requirements and media characteristics fit each other. A person's perceptions combine objective and socially constructed characteristics of task and medium as well as his/her attitudes toward them. Processes influencing the social construction of these perceptions are personal observations of activities within the social context and own past behavior.

Applied to educational IBT usage, the model suggests that student usage behavior is affected by individual differences, personal attitudes toward the medium and the perception of fit between task requirements and media characteristics. If we assume the latter three are in part socially constructed, a student's classmates, instructor, and own past behavior can all significantly influence whether he/she uses the medium.

Structuration theory, critical mass theory and social information processing theory mutually complement each other. Critical mass theory proposes why some media succeed while others fail by identifying mechanisms such as reciprocal interdependence shaping

the social context in which a person operates. The social information processing perspective emphasizes in turn the effects of social context and past choices. Thus it goes beyond the implicit claim of critical mass theory that a person's motivation to adopt/use a technology is based on purely utilitarian grounds. Finally, structuration theory adds a dynamic component and introduces four distinct processes linking social context, IBT (both: institutional level of analysis) and the students' behavior (individual levels of analysis) to each other in a single framework. In sum, we believe that our study can capitalize on the strengths of each theory while their integration helps overcome their idiosyncratic limitations.

3. METHOD

3.1 Overview of the Project

Prior to this study, we conducted a questionnaire-based pilot designed to learn what encouraged students to adopt a particular IBT: a "webboard" (Limayem and Hirt 2000). A webboard is a commercially available software package that incorporates, but is not limited to, features similar to those afforded by electronic bulletin board applications. It is accessed via the Internet and permits registered users to engage in threaded discussions (in both public/open and private forums), online chat, file exchange, and paging of other users.[1] While the pilot explored what encouraged students to adopt the technology, it did not look at the underlying processes involved in adopting and using it.

To tackle these issues, in this study we use a qualitative approach explicitly designed to understand students' views of IBT driving their adoption and usage behavior. The longitudinal study traces a group of students for two consecutive semesters as they use the webboard in two different graduate courses.

3.2 Data Collection and Analysis

We collected three types of data: we recorded original webboard postings, conducted semistructured interviews, and collected archival student data (e.g., term project grades). All interviews were tape-recorded and transcribed verbatim. As an initial step we developed a start list of codes (Miles and Huberman 1994). To do this we employed both inductive (Strauss and Corbin 1990), i.e., data-driven, and theory-based techniques.

(1) Use of data-driven techniques (to code webboard contributions and interviews): A subset of webboard contributions collected during the first semester was retrieved and given to the authors with the objective to develop separately an initial understanding of the contributions found. The authors subsequently met, compared their "coding schemes," and compiled an initial list. This list consisted of a selection of descriptive codes sorting contributions into various "communicative acts" such as "asking for help" or "sharing experiences." These codes were complemented by others that identified a posting's addressee (e.g., instructor, entire class, term project members), topic (e.g., class related, job related, term project related), sender, date sent, times read, times responded to, and so forth. Our intent was to develop the codes so that we could use them to distinguish among contributions based on their content and other (statistical) properties.

(2) Use of theory-based techniques (to code interviews): Using theory as a basis for the development of a start list instills structure to an emergent coding scheme. Furthermore, it helps tie data analysis to the theory (or theories) employed. Based on the main theoretical constructs derived from the three theories, we developed three sets of codes covering both the individual and "institutional" level of analysis. We will later supplement these codes with inductive ones derived through open coding of the interviews (c.f. Strauss and Corbin 1990).

We coded the webboard contributions using part 1 of the coding scheme. The interviews will first be coded openly. In three subsequent iterations they will then be coded using the three individual sets of codes of part 2 of our coding scheme.

We applied some of our initial insights from coding the webboard contributions to develop the interview guide for the second round of interviews. As the project progresses, insights derived during coding will also be used to further refine the coding scheme, to identify patterns and themes, and to establish theoretical propositions.

Data management and analysis is supported by an advanced QDA package (Atlas/ti), a so-called "code-based theory builder" (Muhr 1997; Weitzman 1999; Weitzman and Miles 1995).

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[1]See http://webboard.oreilly.com/.

4. ANTICIPATED CONTRIBUTIONS

We hope our findings will benefit practitioners and researchers alike.

- *Instructors* should be interested in this work for the following reasons. Because of the asynchronous nature of many IBTs, it is often difficult for them to experience first-hand how and under what conditions their students actually use the technology. Furthermore, observing different degrees of student enthusiasm in embracing the technology, instructors may be interested in learning why some students take advantage of the new technologies while others do not. We will use our insights to develop guidelines and "intervention strategies" for instructors to help them encourage students to adopt and keep using IBT. We also hope our contextual description and generous use of examples will assist instructors in interpreting student behavior in their own teaching contexts.

- *System developers* can benefit from our findings by understanding the value of existing system features and interface designs as seen from the student perspective. They can also get valuable ideas for further system enhancements.

- *Academic institutions* may derive helpful criteria from this research, informing them about the merits of IBT in general, and the pros and cons of a specific technology (the webboard), in particular.

- *Researchers* exploring the use of IBT for educational purposes get the opportunity to view IBT usage through three theoretical lenses. This should broaden their understanding of the explanatory power of these theories as applied to IBT support of university education. Furthermore, we hope that this study will lead to the refinement and enrichment of the three integrated theories. Theory extension may be achieved through the discovery of newly found constructs and relationships amending the existing theories. Refinement in turn may be achieved either by breaking down existing constructs into more precise "sub-constructs" (which is likely to facilitate operationalization) or by discovering new constructs and relationships that qualify the original theories.

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References

Alavi, M. "Computer-Mediated Collaborative Learning: An Empirical Evaluation." *MIS Quarterly,* 1994, pp. 159-174.

Alavi, M., Wheeler, B. C., and Valacich, J. S. "Using IT to Reengineer Business Education: An Exploratory Investigation of Collaborative Telelearning." *MIS Quarterly,* 1995, pp. 293-311.

Applebome, P. "Education.com," *The New York Times*, Education Life Supplemental, 1999, pp. 26-29 & 36-37.

Daft, R. L., and Lengel, R. H. "Information Richness: A New Approach to Managerial Behavior and Organization Design," *Research in Organizational Behavior* (6), 1984, pp. 191-233.

Fulk, J., Schmitz, J., and Steinfield, C. W. "A Social Influence Model of Technology Use," in *Organizations and Communication Technology,* J. Fulk and C. W. Steinfield (eds.), Newbury Park, CA: Sage Publications, 1990, pp. 117-141.

Fulk, J., Steinfield, C. W., Schmitz, J., and Power, J. G. "A Social Information Processing Model of Media Use In Organizations," *Communication Research* (14:5), 1987, pp. 529-552.

Giddens, A. *The Constitution of Society: Outline of the Theory of Structuration*, Berkeley, CA: University of California Press, 1984.

Herther, N. K. "Education Over the Web: Distance Learning and the Information Professional," *Online* (21:5), 1997, pp. 63-72.

Leidner, D. E., and Jarvenpaa, S. L. "The Use of Information Technology to Enhance Management School Education: A Theoretical View," *MIS Quarterly,* 1995, pp. 265-291.

Limayem, M., and Hirt S. G. "Internet-Based Teaching: How to Encourage University Students to Adopt Advanced Internet-Based Technologies?" in *Proceedings of the Thirty-third Annual Hawaii International Conference on System Sciences,* R. H. Sprague Jr. (ed.), Los Alamitos, CA: IEEE Computer Society Press, 2000.

Markus, M. L. "Toward a 'Critical Mass' Theory of Interactive Media," *Communication Research* (14:5), 1987, pp. 491-511

Miles, M. B., and Huberman, A. M. *Qualitative Data Analysis,* Thousand Oaks, CA: Sage Publications, 1994.

Muhr, T. *ATLAS/Ti—Visual Qualitative Data Analysis—Management—Model Building—Release 4.1 User's Manual,* Berlin: Scientific Software Development, 1997.

Oliver, P., Marwell, G., and Teixeira, R. "A Theory of the Critical Mass. I. Interdependence, Group Heterogeneity, and the Production of Collective Action," *American Journal of Sociology* (91:3), 1985, pp. 522-556.

Orlikowski, W. J. "The Duality of Technology: Rethinking the Concept of Technology in Organizations," *Organization Science* (3:3), 1992, pp. 398-427.

Orlikowski, W. J., and Robey, D. "Information Technology and the Structuring of Organizations," *Information Systems Research* (2:2) 1991, pp. 143-169.

Peffers, K., and Bloom, S. "Internet-Based Innovations for Teaching IS Courses: The State of Adoption," *Journal of Information Technology Theory & Application* (1:1), 1999, pp. 1998-2000.

Rubin, H. J., and Rubin, I. S. *Qualitative Interviewing: The Art of Hearing Data,*. Thousand Oaks, CA: Sage Publications, 1995.

Salancik, G. R., and Pfeffer, J. "An Examination of Need-Satisfaction Models and Job Attitudes," *Administrative Science Quarterly* (22), 1977, pp. 427-456.

Salancik, G. R., and Pfeffer, J. "A Social Information Processing Approach to Job Attitudes and Task Design," *Administrative Science Quarterly* (23), 1978, pp. 224-253.

Santosus, M. "Wire Education," *CIO Web Business Magazine*, October 1998.

Schmitz, J., and Fulk, J. "Organizational Colleagues, Media Richness, and Electronic Mail: A Test of the Social Influence Model of Technology Use," *Communication Research* (18:4), 1991, pp. 487-523.

Strauss, A. L., and Corbin, J. *Basics of Qualitative Research: Grounded Theory Procedures and Techniques,* Newbury Park, CA: Sage Publications, 1990.

Webster, J. "Teaching Effectiveness in Technology-Mediated Distance Learning," *Academy of Management Journal* (40:6), 1997, pp. 1282-1309.

Weitzman, E. A. "Analyzing Qualitative Data with Computer Software," *Health Services Research* (34:5), 1999, pp. 1241-1263.

Weitzman, E. A., and Miles, M. B. *Computer Programs for Qualitative Data Analysis,* Thousand Oaks, CA: Sage Publications, 1995.