2000

Normative Perception of the Role of IS within the Organization: An Empirical Test of Measuring Student Learning

David S. Taylor
University of Houston, dtaylor@uh.edu

Tim Goles
University of Houston, tgoles@uh.edu

Wynne Chin
University of Houston, wchin@uh.edu

Normative Perception of the Role of IS within the Organization: An Empirical Test of Measuring Student Learning

David S. Taylor, dtaylor@uh.edu
Tim Goles, tgoles@uh.edu
Wynne W. Chin, wchin@uh.edu
Department of Decision and Information Sciences, University of Houston

Abstract:

As we enter the 21st century, the organizational role of IS continues to expand and evolve at a dizzying pace. An understanding of and appreciation for that role is becoming mandatory for *all* managers and executives, not just IS professionals. This paper first determines a generally agreed upon high-level conceptualization of the strategic role IS plays in organizations. It then proceeds to develop and empirically test an instrument and technique (Structural Equation Modeling, or SEM) designed to measure college students' normative perception of that role. The contributions are twofold. First, the instrument can be used to help evaluate how well future business managers and executives truly understand and recognize the value of IS to the organization. This has long-term implications for organizational productivity. Second, the approach can be used as an indicator of educational quality by assessing the extent to which a concept has crystallized within students (deep learning), as opposed to short-term retention and recall (surface learning). This has implications beyond the study of IS roles.

Key Words: IS Education, IS Research Methodology, Learning Models, Strategic Role of IS, Confirmatory Factor Analysis

Introduction

The rapid rate of change in information technology, coupled with the equally rapid diffusion of information systems, has lead to fundamental changes in the role IS plays within organizations. The IS function has evolved from a provider of automated transaction processing and record-keeping services to an essential contributor towards not just organizational success, but its very survival. As we enter the 21st century, this evolution is accelerating and expanding. IS is becoming more and more pervasive, presaging a change in core perceptions of the organizational role IS will play in the new millennium.

Related to the expanded role of IS in organizations, researchers, educators, and practitioners have reached a general agreement that some base level knowledge and understanding of IS concepts is mandatory for all future business professionals. This is reflected in recent remarks by Robert Zmud in the Call For Papers for a themed issue of *MIS Quarterly* devoted to the redefined role of IS (Zmud, 1999), and earlier calls for revamping business school curricula (e.g., Couger et al., 1995; Lee et al., 1995; Ramakrishna et al., 1995). But merely changing the curriculum content is not enough. Colleges and universities must ensure that their students not only learn key IS concepts at the surface level, but embrace them at a deeper level as well (Martin and Saljo, 1976; Ramakrishna et al., 1995; Evans and Honour, 1997). That is, students should move beyond rote memorization to truly understanding, appreciating, and applying the concepts.

Based on the preceding, our research objectives are twofold. First, we seek to determine a generally agreed upon high-level conceptualization of the strategic role IS will play in organizations as they move into the 21st century. Second, we endeavor to develop and validate an instrument to measure an individual's *normative perception* of the strategic role of IS. The purpose of this second objective is not to measure how well a student can parrot back what he or she has been taught. That can be, and usually is, done as part of the grading process. We argue that, given the criticality of IS in today's world, it is crucial that the student's deep-rooted perception of the role of IS be explored to help ensure that future business managers and executives truly understand one of the core concepts of IS.

To achieve these objectives, the remainder of the paper is laid out as follows. In the next section, we establish a framework for evaluating how well a student has learned the currently espoused concept of IS as a means of competitive advantage. After that we examine several notions of the strategic organizational role of IS, and present a generally agreed upon conceptualization of the strategic role IS plays in the current and future business environment. Then we discuss our research methodology and results, including a discussion of using SEM to assess deep learning. Finally, we close with a discussion of the contributions and implications of this research.

A Learning Framework

In order to effectively appraise whether or not a student has "learned", a framework for defining and

evaluating learning must first be put in place. In this study, we use the notion of surface and deep learning, which in turn is based on Bloom's Taxonomy of Learning (Bloom, 1956). The taxonomy consists of three overlapping domains; cognitive, affective, and psychomotor. The cognitive domain addresses the acquisition and use of knowledge. The affective domain deals with internalization of interest, attitude, and values. The psychomotor domain emphasizes physical skills, and is clearly outside the scope of this study. There is some overlap between the cognitive and affective domains, particularly as they relate to the individual placing a value on some phenomenon (Krathwohl et al., 1956). However, since the cognitive domain is primarily concerned with intellectual issues, while the affective domain is more inclined towards feelings and emotions (Reeves, 1990), we will focus on the cognitive domain.

Within the cognitive domain, there are six hierarchical levels, beginning with *knowledge*, or rote memory, and progressing through to *evaluation.* See Table 1 for a fuller description.

Table 1. Bloom's Taxonomy - Cognitive Domain

Level	**Description**
1. Knowledge	Recall of information, ranging from specific facts to more general patterns and theories.
2. Comprehension	A low level of understanding what has been taught.
3. Application	The use of abstractions such as general ideas or methods in particular and concrete situations.
4. Analysis	Breakdown of the material into its constituent elements, relationships and interactions, then relating them to a structure which binds them together.
5. Synthesis	Combining elements into an integrated whole.
6. Evaluation	Making a judgement about the value or worth of ideas, solutions, or methods.

Bloom's Taxonomy is widely used in general educational settings (Kottke and Schuster, 1990). It has also been used in the study of business ethics (Reeves, 1990) and IS education (Hosseini, 1993). However, there is some discussion concerning the precise delineation between the various levels (e.g., Kottke and Schuster, 1990; Seddon, 1978). In order to sidestep some of the debate about exact specification of the levels, other researchers have grouped Bloom's six levels into two. The RECAP model (Imrie, 1984; 1995) divides the cognitive domain into two tiers. Tier 1 is composed of the first three levels of Bloom's taxonomy, while Tier 2 combines levels four through six. The two tiers correspond to what has been described as surface and deep learning (Martin and Saljo, 1976). The concept of surface and deep learning has also been applied to IS education (Cox and Clark, 1998). Both of these simplified taxonomies differentiate between rote memorization of specific pieces of information, and the application *and appreciation* of more abstract concepts. It is this appreciation that will be used to evaluate the individual's normative perception of the strategic role of IS.

The Role of Information Systems

Notwithstanding the voluminous body of scholarly research on how the organizational role of IS has evolved, we chose to focus on a different, although closely related, academic medium - the textbooks used in foundation IS courses in business schools. This approach was selected for three reasons. First, the presentation of material in textbooks usually draws on scholarly research. For example, Zwass' (1998) presentation of the evolution of the role of IS is "based in part on the work of Lynda Applegate … and her colleagues" (p. 84). Similarly, Schultheis and Sumner (1998) adapt the work of Nolan (1979; 1984) to discuss the evolution of IS, and Laudon and Laudon (1998) tie their discussion of the changing conceptions of IS to Porter's (1985) work on competitive advantage. The second reason for focusing on textbooks is that they are the direct and immediate source of information for students.[1] Finally, our focus is on the evolving role of IS today and in the future, not so much its historical progression.

Five foundation-level business school textbooks, designed for both IS and non-IS majors, were examined. Selection of the textbooks was based on informal conversations with various instructors at several different universities, and review of an ISWorld Listserv discussion related to introductory MIS books (Flatto, 1999). While no pretense is made that this is a "scientific sample", we argue this selection is representative of the information contained in the vast majority of such texts. See Exhibit 1

[1] This is not to minimize the role of the instructor. This statement is based on the twin assumptions that: 1) what instructors teach is, for the most part, tied to the text; and 2) students read the text. Hopefully, these assumptions are not too naïve or idealistic.

for a summary of the textbooks' presentation of the changing role of IS.

A common theme running through these books is the premise that some knowledge and understanding of IS concepts is mandatory for future business professionals. There is also general agreement among the textbooks concerning the crucial role IS plays in contributing to the organization's success, both today and in the future (see Table 2). We have distilled these two general notions into a series of questions designed to evaluate an individual's normative perception of the strategic role of IS. The questions are based on Laudon and Laudon's (1998) depiction of the changing conception of the role of information systems. This was not done because we consider Laudon and Laudon's treatment of the subject superior to the other texts: we consider all the textbooks to be high quality works. The choice of Laudon and Laudon is based on both an abstract and a pragmatic basis. Abstractly, they approach the subject as a change in the *conception* of IS, rather than the historical evolution perspective of several of the other books. This is more in line with our desire to assess the normative perception of IS. Pragmatically, this was the text our subjects used in their classes.

Table 2. Current Role of IS

Source	Current Role of IS
Haag et al. (1998)	IS is essential for doing any kind of business. IS is an essential enabler of innovation. (pp. 431-432)
Laudon and Laudon (1998)	IS promotes the survival and prosperity of the firm. (p. 50)
Schultheis and Sumner (1998)	IS is used to leverage business results. (p. 22)
O'Brien (1999)	IS is revolutionizing how the business opportunities and management of successful global enterprises are supported. (p. 55)
Zwass (1998)	IS enhances the firm's competitive position. (p. 10)

Methodology

The study sample consisted of all sections of a core IS course required of all students enrolled in the MBA program at a large southwestern urban university. Participation was voluntary. There were three sections taught by two different instructors. All sections were included, therefore any bias related to selection of a particular section was minimal. All sections used the same text – Laudon and Laudon, 1998.

The instructors allowed us to conduct this study, but were intentionally not informed of our actual hypotheses, questionnaires, and variables being studied. This was done to eliminate any bias and to prevent instructors from changing their teaching styles to influence the outcomes. Each of the instructors is a qualified researcher and understands the value of controls in an experiment.

On the first day of class the students in all sections were given a questionnaire primarily designed to capture normative perceptions of the strategic role of IS. In addition, a variety of information, including demographics, the student's baseline knowledge of the subject matter taught in the course[2], and the student's overall perception of the value of IS were gathered. Following the taxonomies given in the Laudon text we identified three distinct strategic role-types for IS: management control, decision-making, and competitive advantage. There were two measures developed for each of these role-types (see Table 3 for items). There were 147 subjects at this point.

Table 3. Measures Used in Research

Management Control Role: VAL60S1. Other than processing routine transactions, information technology should be primarily used to provide reports for better monitoring, controlling, and administering. VAL60S2. Other than processing routine transactions, information technology's primary role is to provide useful and timely reports for managing.
Decision-making Role: VAL80S1. Other than processing routine transactions, information technology's primary role is to enhance the decision making in the organization. VAL80S2. Other than processing routine transactions, information technology should be primarily used to improve decision making within the organization.
Competitive Advantage Role: VAL90S1. Other than processing routine transactions, the primary role of information technology is to enable the reengineering of the Company's business processes for competitive advantage. VAL90S4. Other than processing routine transactions, the primary role of information technology should be to provide a strategic advantage over a Company's competitors.

[2] Baseline knowledge was assessed using questions from the testbank supplied with the text.

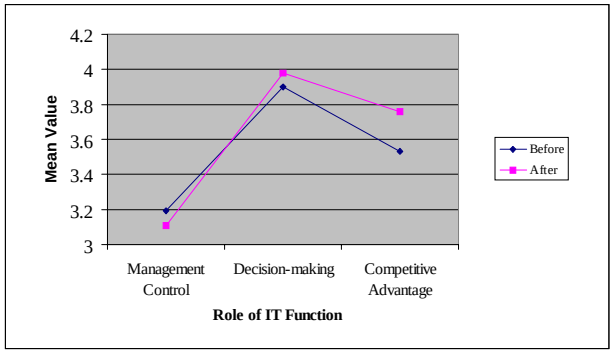
A second questionnaire was administered at the end of the semester. It re-measured the student's knowledge of the subject matter and perception of the role of IS. There were 127 usable responses. All of the scales used were five-point Likert-type scales.

The average age of the students participating in the study was 29 years old. Fifty-seven percent were male. Sixty-seven percent worked full-time and attended the university part-time. Twenty-five percent had Management Information Systems undergraduate degrees, 59% had other business degrees, and 16% were non-business majors (none of which were computer science majors).

Results

The first day (Before) and the last day (After) questionnaire data were matched by the last four digits of the student's social security numbers. After adjusting for students who dropped out or improperly completed their questionnaires, there were 105 matched pairs. It was hypothesized that the students' perception of the role of IS in the organization would move from being oriented towards the earlier role of management control to the more current roles of decision-making and competitive advantage. Using the data, a matched pairs test of means was performed. The results appear in Figure 1. There was little change in perception of the IS role related to management control and decision making. However, there was a significant change (at the .05 level) in the student's perception of IS as a means of competitive advantage, implying that the student's perception of the role of IS has crystallized around that concept of IS.

Figure 1. Change in Perception of the Role of IS (Paired Means Test)



Surface learning can be assessed by counting the number of correct answers using procedures such as multiple choice, true/false, or fill in the blank questions. However, these methods do not necessarily provide a sense of the extent of deep learning, where the key abstract concepts being taught have been internalized. We argue that the use of Structural Equation Modeling (SEM) in the form of a confirmatory factor analysis may provide a better basis for assessing the formation and existence of such learning. SEM represents a technique that allows the researcher to test for the existence of an underlying concept. Often termed as latent variables, abstract concepts such as the differing roles of IS are viewed as unobserved or unmeasured variables and can only be inferred from the covariations of measured or observed variables (Bollen, 1989, p. 11). If we assume that these abstract notions exist and have been internalized in the minds of the students, we would hypothesize that our observed measures (as developed in this paper) will covary to the extent that they are able to tap into these underlying concepts. But, we also recognize and hypothesize that each observed measure is also influenced by other factors such as noise. SEM provides for an explicit test of such a model by examining the congruence of our model stipulating the existence of each underlying abstract concept with the pattern of responses in our observed measures. If this model were incorrect, we would expect to find poor overall model goodness of fit results.

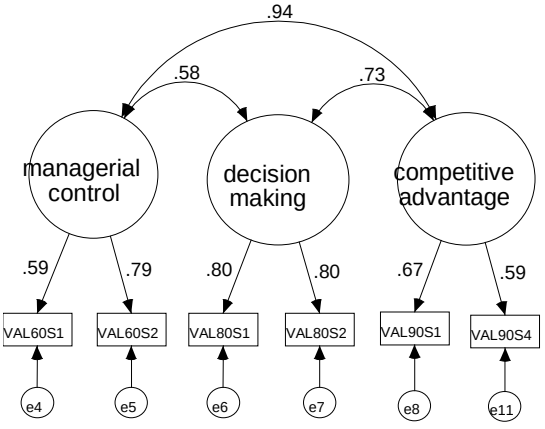
To assess the extent to which the various notions of the role of IS crystallized in the minds of the students, we performed a confirmatory factor analysis using AMOS 4.0, a SEM software package. This analysis provides an assessment of whether deeper learning actually occurred as a result of taking the course. The resulting overall model fit statistics in Table 4 show that deep learning did occur. Prior to taking the course, the various ways of viewing the strategic role of IS (i.e., management control, decision making, and competitive advantage) did not exist in the minds of the students. The poor fit measures show that the three IS roles were not well formed in the minds of the students. This is further demonstrated by examining the correlations among the constructs (as depicted in Figure 2) where the near perfect correlation of 0.94 suggests there is no differentiation between the constructs of managerial control and competitive advantage. In other words, in the minds of the students, the items used for these two constructs were viewed as interchangeable. This conceptual confusion disappeared after taking the course. The overall model fits are all at or above the recommended levels. More importantly, we see that the managerial control and competitive advantage constructs have crystallized into separate constructs (i.e., changing from a standardized correlation of 0.94 to 0.45).

Table 4. Overall Model Fit For the Confirmatory Factor Analysis.

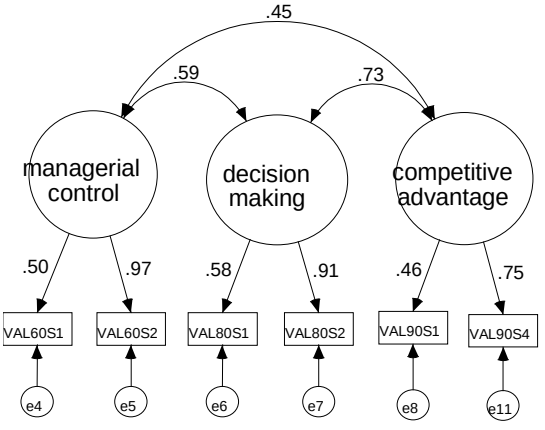
Fit Measures	Recommended levels	Before course (n=147)	After course (n=127)
Degrees of freedom		6	6
Number of parameters		15	15
P	> 0.05	0	0.044
Discrepancy	smaller is better	51.26	12.959
Discrepancy / df	< 5.00	8.543	2.16
RMR	< 0.10	0.08	0.058
GFI	> 0.90	0.899	0.965
Adjusted GFI	> 0.85	0.647	0.877
Normed fit index	> 0.90	0.826	0.93
Incremental fit index	> 0.90	0.844	0.961
Tucker-Lewis index	> 0.90	0.596	0.898
Comparative fit index	> 0.90	0.838	0.959

Figure 2. Confirmatory factor analysis of perceptions of the role of IS (standardized estimates before and after taking the MIS course)

Before



After



Discussion

One of the contributions of this research is the development and validation of an instrument for measuring an individual's normative perception of the strategic role of IS. However, the other contributions go beyond that. The instrument can be used as an indicator of educational quality, in the sense that deep learning (implanting a deep-rooted cognitive perspective in students of the current and future value of IS to organizations) is preferable to surface learning (retention and recall of specific material). It is conceivable that a student can rote recall the various statements of the role of IS as presented in our instrument, but still not make the conceptual differentiation. To assess whether deep learning has taken root, the use of confirmatory factor analysis as applied in this study is required. The results and approach presented here has implications beyond a narrow assessment of students. The students of today are the managers and executives of tomorrow. Their internalized appreciation and evaluation of the organizational role of IS guides their thinking and behavior, which has long-term implications for organizational productivity and the impact of IS on society. The fact that the student sample examined represents graduate students, many of whom work in a managerial capacity, gives pause for consideration. Is it possible that the normative perceptions of the strategic role of IS that IS academics take for granted may not actually exist in the minds of managers? This study raises this possibility and we argue that future research ought to examine how deep-rooted these roles actually are among current business managers.

References

Bloom, B. S. (editor) *Taxonomy of Educational Objectives - Handbook I: Cognitive Domain*, David McKay Company, Inc., New York, 1956.

Bollen, K. A. *Structural Equations With Latent Variables*. John Wiley & Sons, New York, 1989.

Cougar, J.D., Davis, G. B., Dologite, D.G., Feinstein, D.L. et al. "IS '95: Guideline for Undergraduate IS Curriculum," *MIS Quarterly* (19:3), 1995, pp. 341-359.

Cox, K. and Clark, D. "The Use of Formative Quizzes for Deep Learning," *Computer Education*, (30: 3&4), 1998, pp. 157-167.

Evans, B. and Honour, L. "Getting Inside Knowledge: the application of Entwistle's model of surface/deep processing in producing open learning materials," *Educational Psychology*, (17: 1&2), pp. 127-139.

Flatto, J. "Introductory MIS Books," www.commerce.uq.edu.au/isworld/teaching/msg.22-03-1999.html , (Current Mar. 22, 1999).

Haag, S., Cummings, M., and Dawkins, J. *Management Information Systems for the Information Age*, Irwin McGraw-Hill, Boston, 1998.

Hosseini, J. "Application of Bloom's Taxonomy and Piaget Model of Cognitive Processes to Teaching of Management Information Systems Concepts," *Journal of Information Systems Education*, (5:3), 1993.

Imrie, B. W. "In search of academic excellence: samples of experience," *Proceedings of the Tenth International Conference on Improving University Experience*, University of Maryland, University College, 1984, pp. 160-183.

Imrie, B. W., "Assessment for learning: quality and taxonomies," *Assessment & Evaluation in Higher Education*, (20:2), 1995, pp. 175-189.

Kottke, J. L., and Schuster, D. H. "Developing Tests for Measuring Bloom's Learning Outcomes," *Psychological Reports*, (66), 1990, 27-32.

Krathwohl, D. R., Bloom, B. S., and Masis, B. B. *Taxonomy of Educational Objectives - Handbook II: Affective Domain*, David McKay Company, Inc., New York, 1956.

Laudon, K. C. and Laudon, J. P. *Management Information Systems: New Approaches to Organization and Technology*, Prentice Hall, Upper Saddle River, NY, 1998.

Lee, D. M. S., Trauth, E. M., and Farwell, D. "Critical Skills and Knowledge Requirements of IS Professionals: A Joint Academic/Industry Investigation," *MIS Quarterly* (19:3), 1995, 313-341.

Martin, F. and Saljo, R. "On Qualitative Differences in Learning: Outcome and Process," *British Journal of Education Psychology* (46), 1976, pp. 4-11.

Nolan, R. L. "Managing the Crisis in Data Processing," *Harvard Business Review*, March-April 1979, pp. 115-126.

Nolan, R. L. "Managing the Advanced Stages of Computer Technology: Key Research Issues," in *The Information Systems Research Challenge*, F. W. McFarlan (ed.), Harvard Business School Press, Boston, 1984.

O'Brien, J. A. *Management Information Systems: Managing Information Technology in the Internetworked Enterprise*, Irwin McGraw-Hill, Boston, 1999.

Porter, M. *Competitive Advantage*, Free Press, New York, 1985.

Ramakrishna, H. V., Vijayaraman, B. S., and Quarstein, V. A. "Executives Speak Out on MBA's Competency in Information Technology," *Journal of Systems Management* (46:2), 1995, pp. 14-17.

Reeves, M. F. "An Application of Bloom's Taxonomy to the Teaching of Business Ethics," *Journal of Business Ethics*, (9), 1990, pp. 609-616.

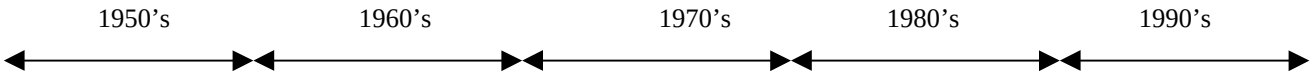
Seddon, G. M. "The properties of Bloom's taxonomy of educational objectives for the cognitive domain," *Review of Educational Research*, (45), 1978, 303-323.

Schultheis, R. and Sumner, M. *Management Information Systems: The Manager's View*, Irwin McGraw-Hill, Boston, 1998.

Zmud, R. "Redefining the Organizational Roles of Information Technology in the Information Age," http://faculty-staff.ou.edu/Z/Robert.W.Zmud-1/theme/ , 1999

Zwass, V. *Foundations of Information Systems*, Irwin McGraw-Hill, Boston, 1998.

Exhibit 1. Changing Roles of Information Systems



		Late 1970's - 1980's: Centralized computing and isolated information (Haag et al, 1998)	1980's - early 1990's: Decentralized computing and isolated information	1990's and beyond: Decentralized computing and shared information

1950 - 1960: EDP era - information as a paper dragon (Laudon and Laudon, 1998)	1960's - 1970's: MIS era - information for general support	1970's - early 1980's: DSS/ESS era - information for management	mid-1980's and beyond: era of ubiquitous computing and universal networking - information as a strategic resource necessary for the firm's survival and prosperity

1950's - 1960's: Data processing era (O'Brien, 1999)	1960's - 1970's: Management reporting era	1970's - 1980's: Decision support era	1980's - 1990's: Strategic and end-user era	1990's and beyond: Enterprise and global networking era

	1960's - 1980's: Data processing era (Schultheis and Sumner, 1998)	1980's - 1995: IT era	1995 and beyond: Network era

mid 1950's - mid 1970's: operational support (Zwass, 1998)	mid 1970's - mid 1980's: management and knowledge work support	mid 1980's - early 1990's: business transformation and competition support	Early 1990's and beyond - ubiquitous computing