APPLICATION OF BLOOM'S TAXONOMY AND PIAGET MODEL OF COGNITIVE PROCESSES TO TEACHING OF MANAGEMENT INFORMATION SYSTEMS CONCEPTS

Dr. Jinoos Hosseini
Information Systems
The Whittemore School of Business and Economics
University of New Hampshire
Durham, NH 03824
(603) 862-3306
E-Mail: J_Hosseini @ UNHH.UNH.EDU

ABSTRACT: Students learn at different rates and in different ways and educators should address various levels of cognition. Management Information Systems are abstract in nature, and therefore it is important to engage students at many levels of cognition to maximize learning. I have adopted Bloom's Taxonomy and the Piaget Model of Cognitive Processes in teaching Management Information Systems concepts. The paper will discuss the application of these models to the teaching of Management Information Systems concepts.

KEYWORDS: Bloom's Taxonomy, Piaget Model, MIS

INTRODUCTION

The objective of this paper is to present a frame of reference to be used for applying various pedagogical techniques for teaching Management Information Systems concepts. I have adopted Bloom's Taxonomy and the Piaget Model of Cognitive Processes in teaching Management Information (MIS) Concepts. Although this frame of reference is used for teaching Management Information Systems concepts, it can be applied to any academic discipline or professional education. Bloom's Taxonomy of Cognitive Domain provides heuristic devices for clarifying cognitive goals. It can be used to implement the pedagogical objectives of MIS. The Piaget Model of Cognitive Processes will illustrate how the mind functions and processes information. This understanding has helped us to design teaching strategies that maximize our learning objectives. The first section of this paper discusses the pedagogical challenges of the graduate level MIS course. The next section describes Bloom's Taxonomy and the Piaget Model of Cognitive Information Processing and their relevance to each other; the third section involves a discussion of the application of these models to the teaching of Management Information Systems concepts.

PEDAGOGICAL CHALLENGES OF THE MANAGEMENT INFORMATION SYSTEMS COURSE

At the leading edge of the industrial world, the United States increasingly is becoming an information society. Over half of the labor force is engaged in some level of information processing. These so-called knowledge workers utilize computers as "engines" powering their jobs.

Given the diffusion of information systems throughout American businesses, business schools have revised their programs to educate qualified managers for the challenges of technological innovation. The American Assembly of Collegiate Schools of Business [1] requires business programs to include a study of information systems as part of the common body of knowledge. Most accredited business schools require an MIS course of all business students[2]. In fact, a survey by Gupta and Seeborg [3] found that 120 out of 139 schools (79%) require a graduate Management Information Systems course in their curriculum. In another survey, McLeod (1985) reported that 62% of accredited business schools (113 schools responding) offer an undergraduate MIS core course. In the future, it would not be surprising to witness close to 100 percent participation in this trend.

This paper will focus on students in information systems at the broad-based MBA level and not those specializing in information systems development or design. This discussion assumes that the goal of a Business Administration program is to train students for effective performance in the business arena of a technologically diverse society.

Although the AACSB requires a basic understanding of MIS concepts and applications as part of the common body of knowledge in business studies, the AACSB has never set forth specific content. Explicit MIS course content can best be described as a "moving target". Ongoing systems research developments and applications can make one year's course content obsolete the next. However, model curricula such as those published by the Data Processing Management Association (DPMA, 1992)[4] and McLeod [3] provide some framework for the concepts to be included in a basic curriculum. Gupta and Seeborg's [2] survey (1989) discovered that a standard set of topics for the graduate MIS course appears to be quite established. The survey reveals the following topics:

1. Systems Analysis and Design
2. Data Base Management Systems
3. Data Base Concepts
4. Decision Support Systems
5. Systems Life Cycle
6. Computer Hardware
7. Information Systems Planning
8. System Theory
9. Information Systems (IS) Organization by Management Level
10. System Implementation
11. Information System Organization by Functional Area
12. Computer Security
13. Data Communications
14. Programming Languages
15. Management Theory
16. System Audit
17. Expert Systems Artificial Intelligence
18. Competitive Uses of IS
19. Other

Teaching students about MIS concepts is particularly challenging because of the following:

1. **MIS concepts are abstract**. It is a challenge to teach these concepts in a classroom. Many concepts depend on tools, experiences, and occasions difficult to recreate in the typical classroom[5]. Although most daytime/full time MBA students have had some corporate experience, their experience using encompassing information systems is limited and therefore have no frame of reference for the concepts discussed in the classroom. This situation is somewhat different for evening and part-time MBA students who generally have had some information systems experience.
2. **MIS concepts are dispersed and interrelated**. As Laudon [6] puts it: "MIS is an exceedingly difficult class to teach. The subject matter is diffuse and hard to communicate." Topics may range from micro concepts (e.g., data base) to macro concepts (e.g., systems analysis and design). Generally, MIS concepts are macro in nature, that is, one is dealing with a large integrated system developed and used throughout the organization. Discussion of various elements of a system tends to be technical (e.g., hardware). On the other hand, a discussion of information systems by management level is considerably less concrete. Many of the processes discussed occur simultaneously in a real situation yet, out of pedagogical necessity, must be discussed sequentially.

Figure 1 shows the interrelationship between various conceptual, technical and abstract MIS topics and illustrates the difficulty of teaching these topics in sequence. Initially, students have difficulty grasping the topics when they are introduced as a whole, since their understanding of the many individual MIS issues involved is incomplete. This difficulty is compounded by the previously-mentioned problem of not being able to understand issues discussed in class because of lack of work experience.

The models presented in the following sections can be applied to any course within the DPMA model curriculum. However, in this paper we have focused on a Management Information Systems course at the graduate level for non-MIS majors.

In the recent past, many models of cognitive information processing have been developed and several cluster classifications have emerged. Developmental models and performance models form one such classification. These models are grouped on the basis of whether or not they incorporate learning. Bloom's taxonomy[7] and Piaget Model[8] exemplify models that explicitly consider learning.

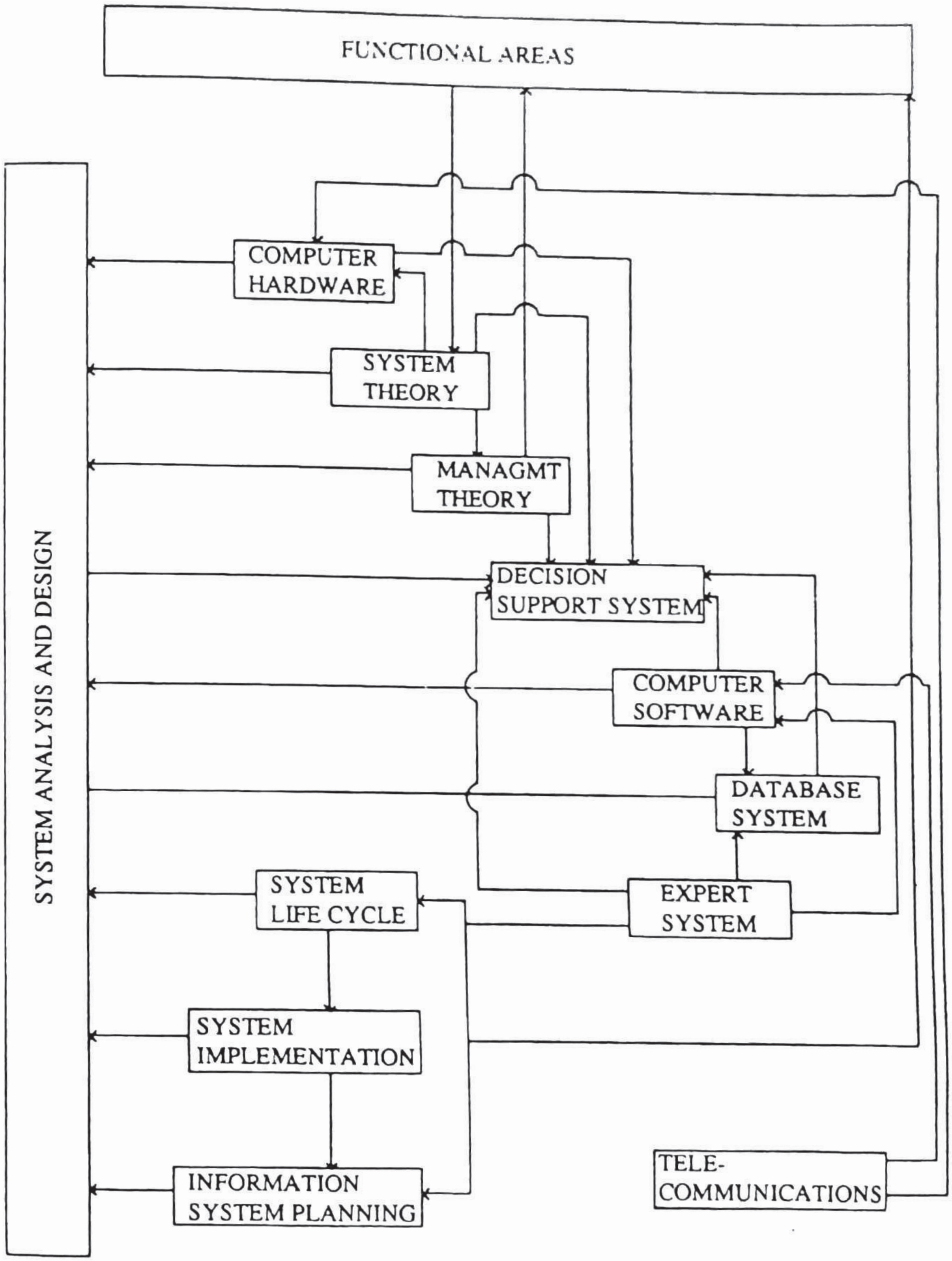
> ***... most teaching objectives can be placed in one of the three major domains or classifications...***

BLOOM'S TAXONOMY OF THE COGNITIVE DOMAIN

Bloom and his colleagues[7] created a threefold division of educational objectives: cognitive, affective, and psychomotor. They asserted that most teaching objectives can be placed in one of the three major domains or classifications:

1. Cognitive: objectives which emphasize remembering or reproducing something that has personally been learned, as well as objectives that involve the solving of some intellectual task for which the individual has to determine the essential problem, then reorder given material, or combine it with ideas, methods or procedures previously learned.
2. Affective domain: objectives which emphasize a feeling tone, an emotion, or a degree of acceptance or rejection. These objectives in the literature are expressed as interest, attitudes and values.
3. Psychomotor: objectives which emphasizes some muscular or motor skill.

Figure 1: THE INTERRELATIONSHIP OF MIS TOPICS



The affective domain is hard to classify and test because it consists of internalized values as well as testable outward behavior. The psychomotor domain deals with physical activity. I forego the discussion of the affective domain because it deals with an individual's private moral judgments. The motor skills domain deals with physical activity that is not applicable to the subject of my study.

According to the Bloom taxonomy of educational objectives, the six levels of the cognitive domain are:

1. knowledge
2. comprehension
3. application
4. analysi
5. synthesis
6. evaluation

What follows is an explanation of the cognitive domains in the context of teaching MIS concepts. The Piaget Model of Cognitive Information Processing will also be discussed where it is relevant.

THE SIX LEVELS OF COGNITIVE EDUCATIONAL OBJECTIVES

Knowledge

In Bloom's Taxonomy, knowledge involves the recall of specifics and universals, the recall methods and processes, or the recall of a forgotten structure or setting. For testing of this knowledge, the recall situation involves remembering the facts.

Comprehension

Comprehension represents the lowest level of understanding and one which can be assumed to be part of the individual's general fund of knowledge. It emphasizes the process of knowing what has been communicated. The manifestation of comprehension shows itself in the student's ability to translate and paraphrase what has been taught. Another aspect of comprehension is interpretation. Interpretation involves a reordering, rearrangement, or new view of the material. The third aspect of comprehension is extrapolation: the extension of trends or tendencies beyond the given data to determine implications or consequences.

Application

According to Bloom's taxonomy, application is defined as the use of abstractions in particular and concrete situations in order to find the solution to a problem. The abstractions may be in the form of general ideas, rules of procedures, or generalized methods. It may also be technical principles, ideas, and theories which must be remembered and applied.

> ***To understand some new piece of information is to relate it to a mentally represented schema and to integrate it with already existing knowledge.***

Analysis and Synthesis

According to Bloom, the skill of analysis is a more advanced level of cognition than the skills of comprehension and application. In comprehension the emphasis is on the grasp of the meaning and intent of the material. In application it is on remembering and bringing to bear upon given material the appropriate generalizations or principles. Analysis emphasizes the breakdown of the material into its constituent parts and detection of the relationships of the parts and the method of their organization. Analysis may also be directed at the techniques and devices used to convey the meaning or to establish the conclusion of a communication. Synthesis, on the other hand, brings together parts or elements to form a whole.

Evaluation

At this stage the student renders judgment about the extent to which the material and methods satisfy criteria. This will include the ability to indicate logical fallacies in arguments. Also, it may include the ability to judge by external standards and the ability to compare a work with the highest known standards in the field especially with other works of recognized excellence.

Analysis, Synthesis, Evaluation, or Reflective Abstraction:

The levels of application, analysis, and synthesis introduced in Bloom's taxonomy parallel a model of Cognitive Information Processing proposed by Piaget [8]. I will describe the Piaget Model and will relate it to Bloom's Taxonomy.

PIAGET MODEL OF COGNITIVE INFORMATION PROCESSING

Piaget's Model introduces the development of a mental frame of reference, called Logico-Mathematical Structures (LMS). LMS follows the idea that to understand something, one must integrate it with already existing knowledge schemata. The paradox of science education is that its goal is to impart new schemata to replace the students existing ideas, which differ from the scientific theories being thought [9], using a framework originally constructed by the student to integrate the former schemata.

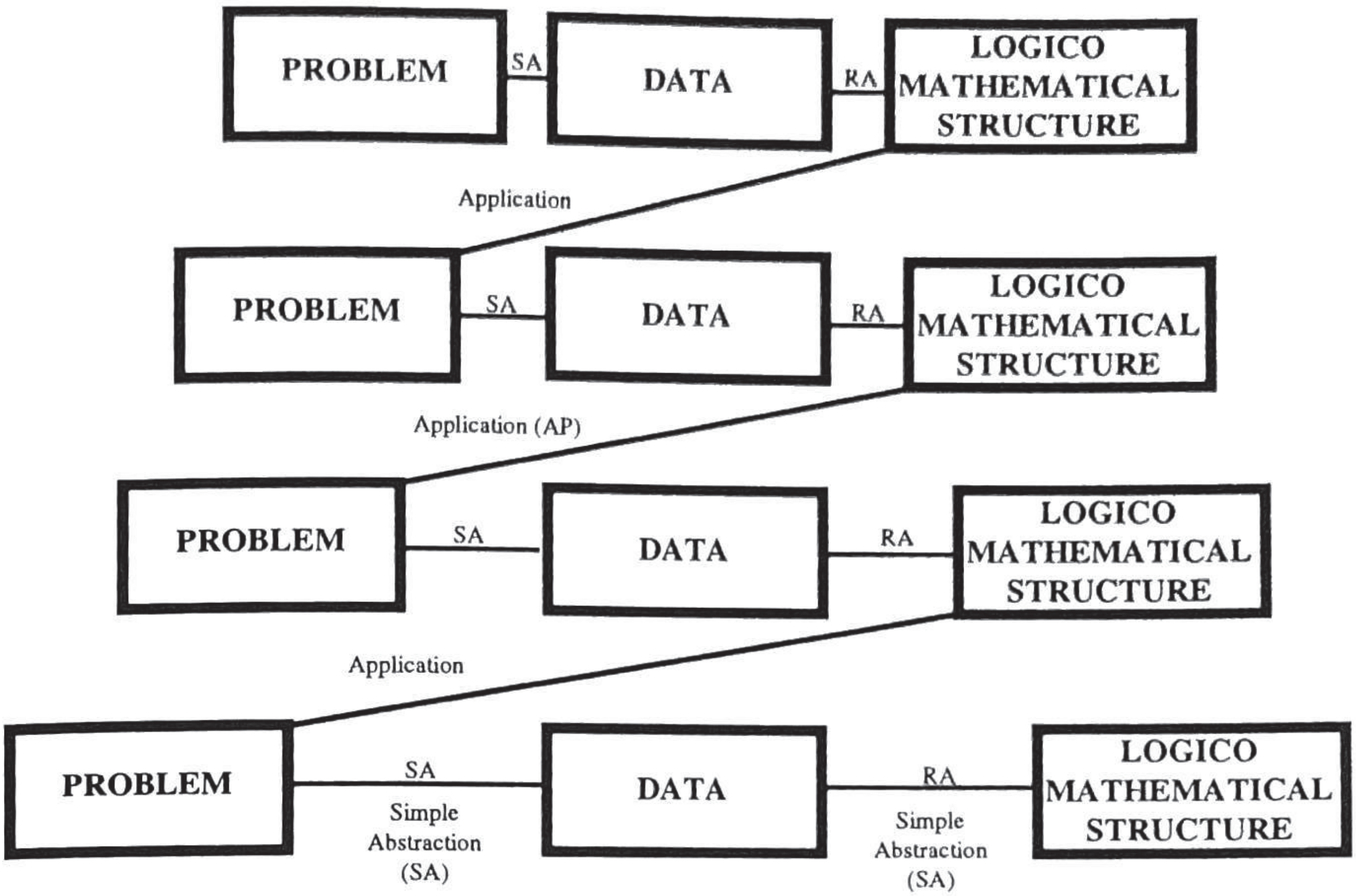
Logico-Mathematical Structures may be likened to an internalized model of reality. It may also be called a cognitive map [10]:

> *"A cognitive map is a specific way of representing a person's assertion about some limited domain such as a policy problem. It is designed to capture the structure of the person's causal assertions and to generate the consequences that follow from this structure."*

The core of Piaget's model is formed of a cycle of three processes: application (AP), simple abstraction (SA), and reflexive abstraction (RA) (See Figure 2).

To understand some new piece of information is to relate it to a mentally represented schema and to integrate it with already existing knowledge. Students reading MIS text or listening to an instructor

Figure 2: PIAGET'S MODEL OF DEVELOPMENT OF LOGICO-MATHEMATICAL-STRUCTURE (LMS)
Source Ramaprasas and Mitroff (1984)



must gain understanding by relating what they are reading to what they already know and this requires active participation. In the case of MIS materials, students do not have the schemata, such as the MIS framework, to form the basis of their understanding. The paradox here is that to understand MIS concepts one has to relate it to the schemata already in place. Furthermore, the goal of the instructor is to expand new schemata for understanding, something not yet in the student's repertoire. For MIS concepts, the student usually lacks the original schemata.

By observing data and understanding a phenomenon, a rudimentary and simple LMS forms. The students collect data during the exploration phase from which concepts can be reinvented; those inventions are accommodations in the mental functioning model. These activities represent the "Experience" and "Logic " activities referred to by Piaget. Experimentation and manipulation of LMS using more data will constitute application (AP). If the result of experimentation, manipulation, or further mental processing of the data do not fit the deductions, LMS is changed through reflexive abstraction (RA). Through further application of new data, elements, and variables, LMS is revised so that at the later stages, the manifest relationship among data becomes less important and the meta-relationship between data becomes more important. This can be illustrated in the ability to ask questions, generate tentative answers, deduce predictions based upon those answers, and to sort through available evidence to verify and/or reject those tentative answers, all inside one's head [11]. When the LMS is sufficiently refined and revised, that is, when there is agreement between what one perceives from data and the internal model of the data, the AP stops. At this point, the LMS becomes the reality, instead of a model of reality. The development of LMS, and consequently learning, ends when application stops and attribution begins [12]. Attribution can be stated in another way [11]:

"The final level begins at the moment when the individual begins to ask questions, not of others, but of himself, and through the gradual "internalization" of elements of the language of the argumentation acquires the ability to "Talk to himself" which constitutes the essence of reflective thought and allows one to internally test a tentative hypothetical statements and arrive at internally reasoned decisions to solve problems."

The Piaget Model of AP, SA, RA is analogous and similar to the higher level of taxonomy proposed by Bloom; application, analysis, synthesis, and evaluation. Bloom refers to analysis as the breakdown of a communication into its constituent elements in such a way that the relative hierarchy of ideas is made clear and/or relations between the ideas expressed are explicit. Synthesis is the putting together of elements and parts so as to form a whole. This includes derivation of a set of abstract relations either to classify or explain particular data or phenomenon. It may also include the deduction of propositions and relations from a set of basic propositions or symbolic representation.

MIS PEDAGOGICAL APPROACHES THAT SUPPORT DIFFERENT LEVELS OF COGNITION

Figure 3 illustrates the compatibility of Bloom's taxonomy and Piaget's model of information processing at different cognitive levels. It also illustrates different pedagogical approaches that support these levels of cognition. The models introduced in this paper attest to the fact that the cognitive domain of the taxonomy is arranged in a hierarchy. This implies a stepping stone process (e.g. Bloom's), as well as a learning cycle (e.g. Piaget's).

The following approaches may be used to teach MIS courses: 1) lecture, 2) question/answers related to lecture material, 3) short case studies with questions, 4) long case studies and questions (e.g. Harvard case studies), 5) hands-on computer assignments using software such as Lotus 1-2-3 and dBase and 6) projects that require students to work with an external organization to apply the concepts and techniques learned in class.

Several methods of teaching MIS support the student's comprehension at the cognitive level.

In order to abstract a process that illustrates the different cognitive learning levels, one can consider the following example. Suppose the topic of discussion is the MIS framework (e.g. TPS, MIS, DSS). There will be first a general lecture on these systems (Knowledge Level). There will then be discussion of lecture material, short case questions and answers about the MIS Framework (Comprehension level). This will be followed by more complex cases when students have to apply their knowledge to a particular situation presented in the case (Analysis and Synthesis).

In addition, working with computers to develop a prototype accounting system will create simple and reflexive abstraction referred to in the Piaget model. Performing the real world project will contribute to attribution, which is a mental representation of reality closest to the framework. What follows is detailed description of this process.

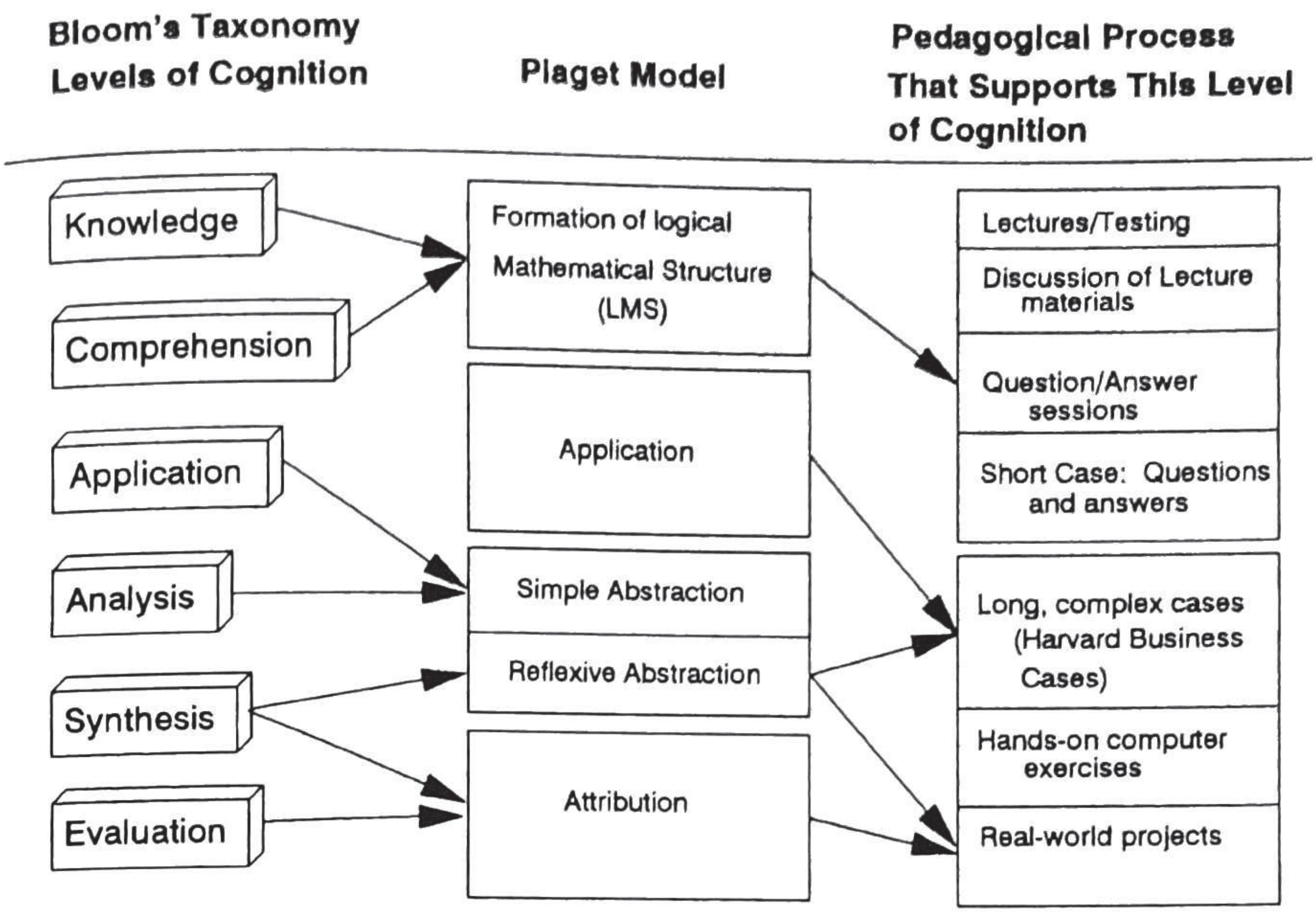
At the knowledge level of the cognitive domain, the psychological processes of remembering are emphasized. The objective of this level in an MIS course will be achieved by lecturing and testing through written examination. The lecture method conveys information fulfilling the first step in the learning process: knowledge. Both the discussion of lecture materials and short case studies promote understanding and fulfill the second objective: comprehension.

There are many concepts that are factual in an MIS course. Discussions of hardware and its components, software and its components, specifics of terminology (e.g. bits, bytes, MIPs, and different sizes of internal memory RAM fall into this category). For reasons of communication and consistency, professionals in the field employ usages, styles, practices, and forms which suit this purpose. In MIS courses this "jargon" is also delivered through lecture. The field is full of acronyms strange to people outside the discipline. In addition, the knowledge of theories and structures is also relayed through lecture method (e.g. Management Information Systems framework, theories of management applicable to this subject, etc.). In a Management Information Systems course, a major part of the subject matter could be taught at this level. Students could memorize facts about such things as computer hardware, software, telecommunications, and information systems planning. Any test questions and class discussions that revolve around recognizing or recalling this knowledge would test this first level of rote memory. Some examples of testing this basic level of knowledge would be: Describe life cycle approach, What are the components of expert system architecture?

Several methods of teaching MIS support the student's comprehension at the cognitive level. The translation stage occurs when students are asked to explain some Information Systems framework in their own words. The second stage of interpretation occurs when students are assigned small cases and are asked to summarize, reorganize, and analyze the facts. Skills of interpretation may be tested during discussion by asking "The end of the chapter questions" found in many books. Some examples are 1) What is a socio-technical system? Why are information systems considered socio-technical systems?

Another stage in comprehension is extrapolation. Within the "Extrapolation" stage, the student's skill in predicting probable consequences and trends based on the presented facts is emphasized. "Can this company sustain a strategic advantage over its competitors since it is using advanced technologies?" Is an example of a question that will test extrapolation. The responses at this level are less informed

Figure 3: PEDAGOGICAL PROCESS THAT FACILITATES DIFFERENT COGNITIVE LEARNING LEVELS



than if the same question is asked at the higher level of cognition. The two levels of knowledge and comprehension are therefore supported by the following listed below. This will lead to the first formation of a mental representation or the LMS.

1. lecture,
2. discussion of lecture materials,
3. question/answer sessions
4. factual analysis of short cases.

Hands-on computer work reinforces abstract concepts introduced in class such as data-base systems and transaction-oriented systems. Long case studies promote critical thinking and serve the objectives of application and analysis. These activities will allow students to apply, analyze, and synthesize what has been discussed in class. This will correspond to simple abstraction, and reflexive abstraction.

Students generally will reach their highest level of cognition by engaging in a real world MIS project. Below, I will discuss one specific project and its contribution to the students' ability to analyze, synthesize, and evaluate in order to reach reflective abstraction. Students were to study a business setting in order to identify a problem area where the solution lent itself to analysis, design and implementation of Information Systems.

REAL WORLD PROJECT

Piaget's attribution is achieved when students complete a project that involved work with a real problem, organization, and information systems. Several students work on the project which usually requires 150-200 hours per group in a semester to complete. The project was one semester long. During class discussion students were urged to share their most current findings and relate them to the topic of that particular class.

For example, at the time we were discussing the framework for MIS, which consists of transaction processes, MIS and DSS, students were to relate these concepts to the company they were studying. They were to identify for the class the transaction systems in place at that particular company, as well as other types of systems. In addition when the topic was on hardware, they described the hardware in existence at their target company. Below is a description of one such project:

The site of a recent student study was Simplex Wire and Cable Company (SWC), producer of communication cables, especially underwater power cable systems, and specializing in the manufacture of long length submarine cables for telecommunications, power, and surveillance. Two students were given specific guidelines for what they had to do and what steps to take. Also available to them was a list of references on library reserve.

The students first familiarized themselves with the company's organizational operation, then wrote a paper delineating the scope and size of the project. They chose to focus on the manufacturing section and toured the manufacturing operation. They further restricted their study to the "Quality Data Acquisition and Report Generation" process. This operation deals with product data collection for the engineering quality control department and the customer. Using sensors and manual observation, the students accomplished data collection on the shop floor. In an effort to focus their results, the student team limited the project's scope to one product, undersea fiber-optic cable. This focused approach resulted in a more meaningful and feasible study.

Application

The process of making deductions about a phenomenon based on LMS, observing the phenomenon based on LMS, and testing the validity of the deductions using data from the observations is called application (AP) of the LMS. Synonymous with experimentation, AP may involve manipulation of phenomenon. If the data in AP do not fit the deductions, the Logico-Mathematical Structure (LMS) is modified through reflective abstraction (RA). RA entails forming a mental map from data perception to the inference of new variables, relationships and patterns from this data. If personal observation and the mental model do not coincide, the student may introduce a new variable or may redefine the relationship between the current variables.

In the first stage of the SWC study, the students analyzed the existing system and identified the problems associated with this system. The students studied the system by direct observation. They observed that the data collection was done manually. Plant employees read off process parameter readings from the sensors and entered them in logs. Quality control personnel consolidated this data with defect and scrap records. The data was used to generate charts and graphs and produce a weekly quality control report. Students directly observed the shop floor. The manual logs and charts generated at the shop floor were studied in detail to discover what information was collected. The students examined logs compiled by a quality analyst. They studied data entered into the spreadsheet programs and reports generated. Interviews with quality control personnel, head of the quality control department, and production personnel revealed the use of the information collected.

Students generally willl reach their highest level of cognition by engaging in a real world MIS project.

According to the Piaget Model of Cognitive Processes, during the inquiry a person develops a Logico-Mathematical Structure (LMS) of a phenomenon. The students already had a basic mental model of the manufacturing process and how the ideal information system supported this process. Therefore, the students' LMS of a manufacturing system and what factors affect and are affected by it determined what factors and relationships were observed.

Through direct observation, data analysis and conversations with employees the students matched the initial LMS developed in class with their deductions (RA). They moved to the application stage (AP) and consequently revised and enlarged their LMS.

In Stage II, the existing data collection and report generation system was analyzed. The students drew a system flowchart and a different level dataflow diagram. Although students were exposed to these tools through textbooks and case problems, they found it a great challenge to actually apply what they had learned in class to a real situation. They found it a further challenge to identify difficult data elements and to differentiate them in a meaningful way. The instructor spent several hours with the students at the plant, teaching them about how to use the system flowchart and data flow diagram, and how to identify data elements. Had they not had the opportunity to do this project in a real setting, the students noted that they would never have appreciated the difficulty of this process.

The project allowed students to work in an unstructured setting. As a result, they had an opportunity to develop their own LMS, SA, and RA. A better LMS framework leads to more refined observation (SA), which facilitates testing (AP) and development (RA) of the LMS. LMS (structure), SA (perception), and RA (strategy) reinforce each other. This interrelationship provides a cyclical movement between the three. As Figure 1 indicates, this operation is narrow at the top, indicating the early stages of inquiry. It is broad at the bottom, indicating later stages of inquiry. When deductions from the LMS fit the data from SA, AP stops. The LMS becomes reality and can be used to solve the problem.

The project requires students to work in groups. Group work provides students with an opportunity to learn communication skills, group dynamics, and methods for making groups work efficiently. Student communication may take different forms: among themselves, with an organization's management, and with plant operators. Group work helps develop skills that are required for effective person-to-person interaction and for the managerial duties students will assume in the future. In addition, students learn a great deal more of the required material when they work in groups [13].

As the student team observed the structure of Simplex Wire and Cable Company, they formed definite perceptions about the present system. The students identified the following problems in Stage II:

1. The Quality Engineer was spending a disproportionate amount of time collecting data and generating reports, rather than analyzing these reports.
2. The Department used an outmoded and inefficient manual filing system, thereby increasing the possibility of human error.
3. There was no database system.
4. The Department lacked adequate data acquisition systems.

In Stage III students performed a comprehensive feasibility analysis of various alternatives to the system in place. This led to defining new system requests and a new proposed system. In the proposed system, the students defined several phases of system implementation, designed files, identified the processing mode, determined the hardware configuration, identified the software and languages that can deliver the new system, and performed a preliminary cost/benefit analysis.

Although the project spanned the entire semester and was time-consuming for both instructor and students, it provided enduring benefits by offering a deeper understanding of the concepts, tools, and techniques discussed in the classroom.

DISCUSSION

The project reinforces classroom instruction and facilitates student learning by allowing them to analyze and design an information system in a real setting. This is invaluable experience for future employment situations. As students work through the different stages of observation, analysis, and inference, they are able to traverse the interactive cycle of cognitive information processing. Students can then make sense of what is being presented to them in the classroom. This approach makes abstract concepts of MIS significantly more concrete.

Using the project as a teaching pedagogy, the instructor can tie together dispersed concepts. Students will see, design and actually work on a database. They will study a functional information system, observe its input/output, and go through the process of analyzing and designing an information system. They will handle actual hardware and peripherals, and most importantly, they will witness the technology at work. Technology advances so rapidly that an instructor cannot demonstrate in a meaningful way the different capabilities that really exist. As students study and work with technologies currently in operation they are able to learn a great deal about these technologies.

> ***Group work provides students with an opportunity to learn communication skills, group dynamics, and methods for making groups work efficiently.***

One of the most significant benefits to this approach is the opportunity it provides for students to work in an unstructured environment. When a student must solve a problem in a classroom setting, most elements of the problem are provided and application is limited to learned techniques. In other words, the controlled classroom environment makes available all pieces of the puzzle and the student simply fits them together. This structured classroom approach is standard in American education and, while the American system offers benefits, providing answers too readily is ultimately patronizing to the students. Accustomed to complacency, students experience a diminished capacity to exercise their minds. They have difficulty searching for information, establishing strategies, finding information, and solving problems.

The establishment of strategies in which to find information and solve problems is a phenomenon called meta-knowledge [14] or meta-cognition. This higher level of knowledge attainment checks the lower level of knowledge cognition and the individual asks "why?", "when?", and "how come?" questions. Students may feel frustrated, but that in itself provides the beneficial learning effect of tolerating ambiguity. According to Harmes and Yager [15], students are accustomed to having answers readily available because "the book" can generally be relied upon to provide answers. The absence of readily available answers causes the students to ask such questions as "Why did that happen?", "Will that event happen again?", " What can be done to change the result of that process?".

Such an approach is a representation of what Piaget calls *disequilibrium*. Disequilibrium is a questioning state brought about by what has been assimilated. Equilibrium is reestablished when adjustments are made between what was known before the assimilation and the new ideas emerging from the assimilation. The learners have now accommodated themselves to a new idea and that new idea must be organized with the other knowledge the learners possess.

Learning in an unstructured environment, as in the project described above, promotes creative thinking, a prized talent in those who make it to the top of any organization. By using this approach, students are no longer passive learners but active participants, employing classroom knowledge to face a very unstructured and imperfect world where there is no "book", information is not readily available, courses of action are unknown, and creative abilities are necessary for effective problem solving. The models explored in this paper are the underlying foundations for what in the literature has been termed a learning cycle [11].

There has been a growing body of literature demonstrating the effectiveness of the instructional strategies explained in this paper. For example, Campbell [16] found that the Piaget approach was significantly better than a traditional approach in provoking students to utilize formal reasoning patterns. Purser and Renner [17] also found similar results. McKinnon and Renner [18], Carlson [19], and other studies have reported that the teaching strategy developed in the context of Piaget theory was found to be superior to a traditional approach in producing gains in formal reasoning and the development of thinking skills. Students in general reported great learning as a result of using this approach. My personal experience, having taught for more than fourteen years, parallels those of the researchers: the strategy developed here has always proved to be superior to the traditional lecturing approach.

> ***MIS concepts are abstract in nature and therefore it is important to engage students at many levels of cognition to maximize learning. Instruction should be reinforced in several ways.***

CONCLUSION

In this paper, we have attempted to achieve the following objectives:

1. to demonstrate the difficulty of teaching Management Information Systems concepts in a classroom environment.
2. to describe the Piaget model and Blooms Taxonomy as a frame of reference for teaching MIS concepts.
3. to propose pedagogical approaches that support different levels of cognition according to Piaget's model and Bloom's taxonomy.

Students learn at different rates and in different ways and educators should address various levels of cognition. MIS concepts are abstract in nature and therefore it is important to engage students at many levels of cognition to maximize learning. Instruction should be reinforced in several ways. The courses that involve students only at lecture level provide factual knowledge which may later be forgotten. Courses that involve not only lecture but the opportunity for students to understand, apply, analyze, and synthesize the material will have lasting impact. Students faced with a similar problem years later will be able to apply learned skills to find an appropriate solution.

In summary, I have demonstrated that the six levels in Bloom's classification of the cognitive domain of global educational objectives and the Piaget Model are applicable to teaching Management Information Systems concepts.

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AUTHOR'S BIOGRAPHY

Jinoos Hosseini is Associate Professor of Management Information Systems at the University of New Hampshire. She received her Ph.D. from the University of Arizona and has published extensively in areas of Cognitive Information Processing. Decision Processes, Artificial Intelligence and Expert Systems. Her research has appeared in Interfaces, International Journal of Policy and Information, and Journal of AI in Engineering to name a few. She has also been consultant to large organizations and has developed and implemented Computer-based Information systems. She has also been very active in Curriculum Development and has a special interest in developing pedagogical approaches in teaching MIS Concepts. Her research on Cognitive Information Processing, especially as it relates to teaching, has appeared in Journal of Instructional Sciences and Journal of Reading Behavior.