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BOSTON UNIVERSITY

SCHOOL OF EDUCATION

Dissertation

APPLICATION OF SYSTEM DYNAMICS AS A STRATEGY FOR TEACHING MANAGEMENT CONCEPTS

BY

JOHN K. EVANS

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Submitted in partial fulfillment of the

requirements for the degree of

Doctor of Education

1988

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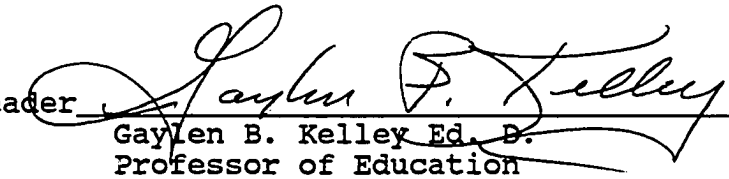
Second Reader 

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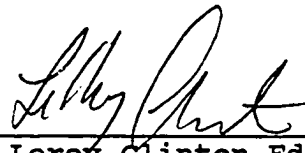
Third Reader 

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wife Dorothy, who was able to put up with my hectic lifestyle over the past seven years and still maintain both her sanity and loving devotion. To my sons, Scott, Lance, and Ryan who understood why I was always studying or gone. And finally, to my daughter Kellee, whose skills with Word Perfect made it all come together. Words seem inadequate to express the appreciation which I have for the time and effort she has put into the typing of this manuscript.

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APPLICATION OF SYSTEM DYNAMICS

AS A STRATEGY FOR TEACHING MANAGEMENT CONCEPTS

(Order No.)

John K. Evans, Ed. D.

Boston University School of Education, 1988

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ABSTRACT

The purpose of this study was to investigate the effects which a specifically designed teaching model (one that incorporated System Dynamics) would have on the enhancement of student learning in undergraduate management subjects. System Dynamics is a structured methodology used to analyze and evaluate the variables contained within a system and places emphasis on causal or influence relationships. All of the System Dynamics applications used in the teaching model were qualitative and not quantitative in nature.

Particular attention was given to the investigation and measurement of the three higher order learning functions identified in Bloom's Taxonomy of Education Objectives: 1) analysis, 2) synthesis, and 3) evaluation of data as it relates to the learning process. It is important to note that these areas of cognitive activity are frequently associated with literature which explores the construct of "critical thinking."

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The research was conducted as a quasi-experiment and utilized two classes in Human Resource Management as control and experimental groups. A total of sixty-seven students participated in the study. Data used for hypothesis testing was gathered from instruments which were either developed by this researcher or purchased from professional testing services. A pretest-posttest format was used throughout.

Hypotheses were tested covering four independent variables: 1) Grade Point Average, 2) Writing Sample, 3) Critical Thinking Appraisal (pretest - Form A), and 4) Objective Pretest of Knowledge, along with four dependent variables: 1) Objective Posttest of Knowledge, 2) Objective Posttest (using "next best" answer criteria), 3) Restricted Response Essay Examination, and 4) Critical Thinking Appraisal (posttest - Form B). Multiple Regression was used to identify the strength of association of independent variables with dependent variables to select covariants to be used in hypotheses testing. Analysis of Covariance techniques were then applied to the data which resulted in the following findings: (1) There was no significant positive correlation between use of the teaching model and enhanced student performance on an objective test which recognized only one correct answer per question. (2) There was a significant positive correlation between use of the teaching model and enhanced student performance on an objective test which recognized the "next best" answer, or most positive detractor, as also being considered a correct answer. (3) There was

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significant positive correlation between use of the teaching model and enhanced student performance on the restricted response essay question. (4) there was no significant positive correlation between use of the teaching model and enhanced student performance on the Critical Thinking Appraisal instrument designed to evaluate higher order thinking abilities.

A more detailed presentation of the results may be found in the main text of this study, along with implications, observations, and recommendations.

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CHAPTER I

INTRODUCTION AND STATEMENT OF THE PROBLEM

Statement of the Problem

The American educational system has come under a great deal of criticism over the past few years for its failure to provide adequate education instruction. One of the areas frequently sited as being of great concern is the inability of the system to provide a learning environment that will sufficiently challenge and motivate students to become active participants in the educational process. During the past fifteen years, several reports have been published by the Carnegie Foundation For The Advancement of Teaching and The National Commission on Excellence in Education that, in part, were critical of the level of education being provided by undergraduate and graduate institutions of higher education. That criticism contained an implicit (and sometimes explicit) indictment of the standards, expectations, and teaching methods used in colleges and universities.

The U.S. Commission on Higher Education in its publication A Nation At Risk: The Imperative for Educational Reform, (1983) states in (Recommendation B: Standards and Expectations) that:

> "We recommend that schools, colleges, and universities adopt more rigorous and measurable standards, and higher expectations, for academic performance and student conduct, and that 4-year colleges and universities raise their requirements for admission. This will help students do their best educationally with challenging materials in

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> an environment that supports learning and authentic accomplishment."

This report further elaborates under its suggestions for implementing recommendations that:

> "Textbooks and other tools of learning and teaching should be upgraded and updated to assure more rigorous content. We call upon university scientists, scholars, and members of professional societies, in collaboration with master teachers, to help in this task, as they did in the post-Sputnik era. They should assist willing publishers in developing the products or publish their own alternatives where there are persistent inadequacies."

This researcher believes that much of the teaching and learning strategy used in higher education institutions today reflects those characteristics that have become cause for concern among educational reformists in this country. As an example, the traditional approach found in the teaching of undergraduate management subjects in most colleges is one that does not differ greatly from the pedagogy used 30 or 40 years ago. Students are lectured to, participate in class discussions (maybe), given case studies or other problems to solve, and for the most part subjected to a barrage of objective examinations. It is this typically non-creative, non-stimulating approach to learning that has provided organizations, like the Carnegie Foundation, with ammunition to support its contentions about the state of the American educational system.

Today's undergraduate college students are, for the most part, being engaged with teaching methodologies which do not encourage or challenge them to think in an analytical manner,

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but encourage practices which enhance short term retention of facts strictly for the purpose of testing.

It is the responsibility of all teachers as professionals to constantly challenge themselves and their students to reach new levels of excellence. To this end, attempts to improve on the delivery of instructional content should be explored with enthusiasm and purpose. In the opinion of this researcher, it is time to promote and integrate the development of instructional technologies that invoke higher order thinking skills. Those skills, which have been most recently associated with the construct of "critical thinking", are often identified with Bloom's (1974) three highest order learning objectives, analysis, synthesis, and evaluation of data.

During the past twenty-five years, much research has been done on approaches to learning that deal with the area of critical thinking as it relates to higher order cognitive development. This period has come to be recognized as the era of "new cognition." One of the major trends to emerge during this period was the growing awareness and development of instructional psychology as a legitimate discipline within the field of education.

With the Soviet launch of the Sputnik satellite in 1957, a massively funded curriculum reform effort was undertaken by the United States. The goal of this effort was to produce a new class of disciplined thinkers through the use of discovery learning and student involvement. This brought about a requirement to redesign curriculums in a manner that would

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foster the development of student thinking skills and encourage the construction of new instructional technologies: those which would facilitate turning learning theory into practice.

Two of the most preeminent educational psychologists of this period, Jean Piaget and Jerome Brunner, were both proponents of the cognitive approach to educational development and learning theory. Specifically, Piaget (1977) advocated a cognitive development approach which emphasized three basic processes: assimilation, accommodation, and equilibration. Briefly stated, assimilation is the absorption of new data with existing cognitive structure; accommodation is the adjustment of cognitive structure to the new situation; and equilibration is the constant readjustment process between assimilation and accommodation.

Jerome Brunner, as the Director of the Harvard Center for Cognitive Studies in the 1960's, was particulary interested in the curriculum design aspects of cognitive development theory. Much of his work was focused on the design of effective curriculum-development models, along with the related instructional psychology. Brunner (1960) advocated an instructional theory that would outline and describe principles for the design of <u>effective</u> classroom instruction. In Brunner's view (1964), a learning theory is descriptive, where as a theory of instruction is prescriptive.

Cognitive development is described by Brunner (1966) as consisting of three levels or stages. The first, <u>enactive</u>, is the representation of knowledge in action (i.e. we learn by

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doing). The second, iconic, is that of visual summarization (i.e. by drawing or diagram). The third, and most advanced stage, is that of symbolic representation (i.e. using words or symbols as restatement to describe experience). It is his belief that the subject matter should be represented in terms of how each individual views the world--enactive, iconic, and representational. Curriculum should be designed so that the mastery of a set of skills leads to the understanding and incorporation of more powerful skills.

The similarities of the cognitive psychology approach to the process of learning and education may be observed in the writings of both Piaget and Brunner. Although the former concentrates his efforts primarily in the area of cognitive development theory, the latter is more interested in instructional design as it relates to cognitive development. Brunner's curriculum-development approach relates directly to instructional strategies; his cognitive model focuses on the mind and its operations. This is somewhat in contrast to, but not in complete disagreement with, Piaget's interactionist perspective on cognitive development which assumes that behavior, mental process, and the environment are all interrelated. Both Brunner and Piaget have long championed the discovery learning styles. However, it should be pointed out that Brunner prefers to use the term "inquiry training" when he refers to problem-solving or participative modes of educational experience.

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It is the opinion of this researcher that Brunner's cognitive development model, with its focus on instructional strategies, is the most appropriate method to incorporate learning techniques designed to enhance higher order (critical thinking) skills. As such, it has been chosen as the philosophical premise for this research paper.

Proposed Approach Of This Study

The major focus of this research was on the development, implementation, and evaluation of a teaching model designed to enhance student learning of undergraduate management subjects. It is to that objective that this researcher has chosen System Dynamics as a way to best represent a teaching strategy which will incorporate Brunner's instructionalist philosophy. Through the use of a teaching model that incorporates System Dynamics techniques, and uses special exercises designed to reduce student passivity roles in learning, this researcher attempted to evoke the enactive, iconic, and representational modes directly identified with Brunner's theories on effective learning.

Briefly stated, System Dynamics is a structured methodology used to evaluate and analyze the components or variables found in systems. There are three critical areas of the System Dynamics approach to the development of models as learning tools which are important considerations in their construction and use. These are: 1) thinking about the model, 2) consideration of the cause and effect/influence relationship

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between the variables with a focus on feedback linkages which demonstrate the placement of selected variables into a loop diagram format, and 3) determining the appropriate boundaries for defining what is to be included in a system.

It is important to remember that it is impossible to identify the components of any system without a clear understanding of what problem is to be addressed and who is interested in the problem. For this reason the System Dynamics approach to modeling uses two important schemes to clarify what should be included about a problem. First, one should think about the problem in terms of how one or more variables represent changes in quantity over time (the word dynamic implies change). The second, deals with thinking about whether there is, in fact, a substantial feedback relationship existing between the variables.

It is the belief of this researcher that System Dynamics provides an effective approach to the presentation of materials for learning in a manner which engages the student in higher order cognitive processes. In order to implement the development and understanding of content materials as they relate to complete systems, students' must engage in the activities of analysis, synthesis, and evaluation. This engagement is by definition a form of "critical thinking" which should enhance learning results if properly applied through the use of System Dynamics modeling as part of a total strategy for learning.

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In order to effectively implement System Dynamics modeling into a classroom environment for purposes of this research experiment, the following steps have been taken. First, the classroom experience analyzed in this research has been developed and structured to represent all materials in the form of synergistic systems through the use of a teaching model, which included System Dynamics techniques (See Appendix: A, Teaching Model). Participation on the part of those students who comprised the experimental group population was designed to evoke a simulated environment of the representation of knowledge by enactive, or learning by doing experiences. (Brunners' first stage for effective cognitive development.)

The second level of Brunner's approach to successful learning is described as iconic or visual summarization. The actual student involvement in model building activities required the construction of model or system loops which provided visual representation of their efforts.

The third and final stage of students' involvement, representational or restatement to describe experience, required that all model systems under study be constantly reevaluated to identify possible different combinations of cause or influence relationships between the subject variables under study.

It is the feeling of this researcher that the formal inclusion of these steps into a teaching model designed around their use will help students to identify with, and make use of, "critical thinking" approaches. This engagement in "discovery

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learning" or "inquiry training" will better equip the learner to gain perceptual insights into concepts and problems which require the use of higher order cognitive skills.

The principal application of this model was on undergraduate Management students; specifically, those who were studying Human Resource Management. A deliberate attempt was made to expand their ability to think about concepts not as separate entities, but as parts of the whole. This model incorporates into its methodology a structure designed to make students identify and think about causal/influence relationships which exist between the various elements of the discipline which they are studying. To this end, it is the purpose of this study to investigate the impact that this approach to learning will have on both the lower and higher cognitive domain learning activities as identified by Bloom (1974) in his Taxonomy Of Educational Objectives.

First, the study explores the affect (if any) which the model has on knowledge, the lowest level of educational objectives. It also explores the higher domain cognitive functions, the effective analysis, synthesis, and evaluation of data. These areas in particular are often associated with the construct of "critical thinking." For the purpose of this study, critical thinking has been operationalized to mean the three higher order learning activities outlined in Bloom's Taxonomy. Specific definition of this construct is important because of the ongoing debate among educational specialists as

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to what is meant by "critical thinking," and whether it is truly capable of being taught or just enhanced.

It is not the intent of this study to teach critical thinking, but to test a teaching methodology which will attempt to engender the development of enhanced higher order learning as it applies to Management subjects.

Statement Of The Hypotheses

Because this proposed teaching model postulates the conditions under which student participation in the learning process will be enhanced through the inclusion of systematic identification and association of subject material variables found in Human Resource Management courses, three hypotheses are presented for investigation:

Hypothesis Number One

Undergraduate college students who participate in a learning environment which uses a teaching model that incorporates the System Dynamics analysis technique as part of a strategy for learning enhancement will:

1) score higher on an objective examination designed to test their general knowledge of Human Resource Management, and
2) have a greater ability to identify the "next best" correct answer when they get the question wrong.

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Hypothesis Number Two

Undergraduate college students who participate in a learning environment which uses a teaching model that incorporates the System Dynamics analysis technique as part of a strategy for learning enhancement will score higher on an essay examination designed to engender the higher order cognitive domain functions of analysis, synthesis, and evaluation.

Hypothesis Number Three

Undergraduate college students who participate in a learning environment which uses a teaching model that incorporates the System Dynamics analysis technique as part of a strategy for learning enhancement will score higher on the Watson-Glaser Critical Thinking Appraisal designed specifically to measure student critical thinking abilities in the areas of inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments, than students not receiving the model.

Limitations Of The Study

This study is bounded by certain constraints which prohibit generalization of its findings to educational settings which are different than that in which this experiment was conducted. Specifically:

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1) The population on which this study focuses is made up of students in a 4 year business college whose traditional age is between 18 and 21. The enrolled undergraduate, resident population generally consists of between 1,500 and 1,600 students. The school is relatively small, and features a curriculum that emphasizes a business education. These are some of the variables, which help to determine the "type" of student who attends this college. Therefore, the findings of this study should not necessarily be applied to students who are attracted to larger schools with different curricula emphasis.

2) This study is confined to the subject area of Human Resource Management and results should not necessarily be generalized to other disciplines.

3) The undergraduate population of the college is predominantly white and from middle class families. As such, these are key variables which limit the generability of this to other ethnic or socioeconomic groups.

4) The combined verbal and math Scholastic Aptitude Scores (SAT's) for the average New Hampshire College Student is 880. This is nearly 100 points below the National average for 1987. Because of this fact, it

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is reasonable to assume a certain amount of underachievement and unpreparedness exists within the student population. This is a factor to be considered when making evaluations and/or generalizations of experimental findings.

Definition Of Operational Terms

1. System Dynamics - A methodology which uses model building to establish a visual representation of the various components in a system through the use of diagrams designed to show feedback and interrelationships. (The presentation of materials in this manner marks the distinction between linear and dynamic thinking; that means and ends are always connected dynamically through feedback loops, and that a change in one variable will affect a change in other variables throughout the system.)

2. Causal/Influence Relationship - Observed behavior within a system that identifies the effect that one or more variable components have on other components in that system. (A series of variable relationships identified by a (+) sign, indicating positive feedback loops, cause the variables to exhibit a "snowball" effect which can lead to accelerating growth or decline in the quantifiable aspects of this relationship, Variable relationships which contain a (-) negative sign, indicating negative feedback

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loops, tend to produce a "thermostatic" effect which over time is "stabilizing" or "goal-seeking.")

3. Teaching Model - A methodology of instruction specifically designed to propagate a learning style which incorporates the use of System Dynamics for the purpose of measuring its impact on learning. (A definition generated by this researcher for use in conjunction with the research project.)

4. Learning Strategy - A tactic for learning that is designed to alter or change the way in which students go about the acquisition of knowledge.

5. Critical Thinking - The use of higher order cognitive domain functions for the purpose of analysis, synthesis, and evaluation of data in order to permit the formulation of logical responses to questions or problem solving requirements.

6. Expository Teaching - A teaching technique of presenting to the student the information he or she is to acquire through the use of traditional pedagogy. (For research purposes, this approach was used with the control population taking part in this study.)

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7. Discovery Teaching/Inquiry Training - The student should discover the truths to be learned because he or she will benefit more from knowledge acquired through problem solving and discovery than from the same knowledge presented in a lecture format. (This issue is of particular interest in that a major claim for discovery learning, or inquiry training, is that it leads to greater transfer of knowledge. Both Piaget and Brunner espouse teaching methodologies which embrace this approach.)

8. Modified Expository Teaching - The student is presented the information to be learned in a particular format, such as System Dynamics Models, and is then required to utilize an inquiry process in order to identify the meaning, relationship, and causal identification of subject material variables. (This approach was used on the experimental group through the incorporation of the teaching model.)

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CHAPTER II

SELECTED REVIEW OF THE LITERATURE

Introduction

While conducting a review of the literature on the use of System Dynamics technique as an instructional tool for the purpose of enhancing the learning process, it became evident that a distinction needed to be drawn between the teaching of System Dynamics as a "stand-alone" discipline and its specific use as part of a teaching model.

The former utilizes System Dynamics technique as a formal tool (one of many) to assist in the analysis of any designated system and its related parts. The latter uses this inquiry technique as part of an overall strategy to bring about the communication of information and ideas that are required to achieve understanding, and thus knowledge, about a specific discipline (i.e. Physics, Management, Public Speaking etc.).

Practitioners in this field have talked about the potential benefits of System Dynamics as a teaching tool, and have long advocated its incorporation into a teaching strategy. Although several examples of its use were found, each attesting to the successful application and benefit of its implementation, none of the examples provided quantifiable data that could substantiate the claims of its effectiveness.

The lack of acceptance of System Dynamics in the world of academe is corroborated by a survey of current use and practices conducted by the System Dynamics Review (Clauset,

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Karl H. Jr., "Notes on the teaching of System Dynamics", Summer, 1985) which concludes that most courses taught in the field are of the elective variety, geared to a graduate audience, and taught by system dynamicists as stand-alone courses that are not well integrated into the mainstream of academic programs. A total of sixty inquires were made to system dynamicists asking about courses taught at their respective schools. Only nine replies were received. The results of this survey were not particularly surprising to this researcher given the fact that acceptance of the System Dynamics paradigm has been somewhat slowed by its emphasis on, and restricted use in, the building of quantitative simulation models.

Three areas must be considered in order to understand the evolution of System Dynamics epistemology as a tool for educational application. First, the early developmental stages as a quantitative discipline specifically designed to be used for the analysis of systems. Second, the recent advocacy of qualitative approaches in its use, and third, some pertinent examples of its introduction as a tool for learning enhancement.

Developmental Perspective Of The System Dynamics Methodology

The conceptualization and development of System Dynamics as an inquiry method took place in the late 1950's and early 1960's under the tutelage of Jay Forrester while at the Massachusetts Institute of Technology. His work on "The Impact

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of Feedback Control Concepts On Management Sciences", delivered at the annual board meeting of the Foundation for Instrumentation and Education in 1960, introduced the idea that System Dynamics - with its concept of feedback loops and use of difference and differential equations - could be used as a pragmatic tool for the purpose of analyzing social and economic systems. One would not be incorrect as identifying this time frame as being the formal introduction of quantitative System Dynamics.

Over the next several years, Forrester and his disciples (Alexander Pugh, D. H. Meadows, etc.) developed and articulated several macro level models which dealt with problems of urban, industrial, and economic concerns. From the period of 1960 to approximately 1980, System Dynamics was considered the field of a "privileged few" who were either capable, or desirous of, dealing with the mathematical nature of its use. This fact became one of the initial roadblocks to its wider range of acceptance and usage as an inquiry method. However, things have started to change dramatically over the last few years. During this time, there has been an increased advocacy for the inclusion of qualitative uses of System Dynamics technique, and the discipline has begun an evolutionary process toward the encompassment of a much broader definition of the methodology and its application. This dichotomy had begun to produce a clear distinction between the quantitative analysis mode, (using the continuous simulation techniques compatible with

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differential equation models), and the system description, or qualitative analysis mode, of System Dynamics.

Since the focus of this research project was on the qualitative use of System Dynamics the review of literature concentrated on publications that either call for an increased recognition of its qualitative use potential, or its inclusion in teaching applications. Because of the somewhat limited acceptance of System Dynamics within the academic community, sources of information about the discipline were primarily limited to journals and periodicals dedicated to the enhancement and dissemination of ideas relevant to the field. These were: Dynamica, Systems Dynamics Review, International System Dynamics Conference Papers, and The Journal of Operational Research Society.

In "System Dynamics' Silver Anniversary: A Time For Reflection and Reformulation" (Dynamica, Vol. 7, 1981), Fey challenged his colleagues to use System Dynamics to explore ways to assist in its own development and acceptance as a prerequisite to further growth. As a response to this challenge, Wolstenholm (1982) suggested that efforts be renewed within the field to identify and examine that part of the environment of the field which could best be influenced by an increased focus of attention. Specific reference was made to the fact that academic practitioners were all too often made very much aware of the need to balance their teaching across other areas and the resulting dilution effect which this had on

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their attempts to incorporate System Dynamics into classroom activities.

The idea of presenting System Dynamics to a broader audience was further articulated by Wolstenholm in an article entitled "System Dynamics: A System Methodology or a System Modeling Technique", (Dynamica, Vol. 9, Winter 1983). It was suggested that System Dynamics be expanded to an increasing role as a method of system description and qualitative simulation analysis by presenting a revised perception of the subject; one which would both complement its traditional use, as well as make it more available as a tool for general analysis in a wide range of inquiry fields. It was in this article that Wolstenholm suggested that the term causal/feedback loops be expanded to consider the notion of influence impact, and thus reduce its association with mathematical equations for purposes of explaining variable changes in precisely quantifiable terms of rate or flow exchange.

Wolstenholm and Coyle (1983) suggested that the application of System Dynamics be considered as a viable two step process, one that would provide a procedure for system enquiry applicable over a wide range of system types, and capable of giving guidance with problem identification, analysis, and implementation. In effect, the two stages would provide: 1) the application of a stepwise method of system description for problem development and qualitative analysis; and 2) the application of continuous simulation techniques for

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quantitative analysis. This approach suggested the use of a taxonomy of System Dynamics models and was premised on their assessment that systems in a wide variety of fields contain structurally similar elements. It was also their belief that these elements could be taught, just as the game of Chess can be taught, by learning structural patterns. (This article was influential in this researcher's decision to attempt the application of System Dynamics technique to a teaching model which would deal with a specific discipline such as Human Resource Management. The necessity to modularize materials in order to show meaningful qualitative influence among and between variables in subsystems was considered essential to this researcher for meaningful lesson-plan construction and methodology implantation.)

The idea of subsystem design was further elaborated by Coyle (1983). Specific attention was paid to influences which arise from flows within a system and are described by what he calls an "influence diagram." He identifies an influence diagram algorithm which outlines key points as prerequisites to diagram construction. These include such areas as: recognition of key variables; identification of system resources and their states; construction of flow modules, etc.

The need for increased awareness of the flexibility of System Dynamics as a tool for analysis has continued to be addressed by practitioners in this field. According to Wolstenholm, ("A Methodology For Qualitative System Dynamics,"

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presented at the proceedings of the International System Dynamics Conference, Keystone, Colorado, July 1985),

> "Whilst there is no clear dividing line between qualitative and quantitative system dynamics, in that models must always be constructed bearing in mind the order of magnitude of the variables specified and the underlying time horizon considered, qualitative system dynamics (Q. S. D.) is taken here to represent system dynamics without specific quantification of variables and computer simulation analysis."

DiStefano (1986) argues cogently for the importance of logical qualitative analysis of complex problems in her article dealing with the user friendliness of System Dynamics. Among her many recommendations is a suggestion for the promotion of more synergy of system dynamicists with experts from other fields, and its broader incorporation as a learning medium.

This portion of the literature review was extremely important to an understanding of how the use and view of System Dynamics is presently changing, and why it has often been considered the exclusive domain of those who have chosen to persevere within the realm of its quantitative modes.

System Dynamics In Education As A Tool For Learning Enhancement

Much of the literature that was reviewed in this area dealt with various academic institutions which had included System Dynamics courses in their curriculum for purposes of introducing and/or exposing their students to its value as a structured means of problem analysis and system simulation. In most cases, it represented the efforts of practicing system

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dynamicists to apply the System Dynamics technique to classroom situations in which they felt it could be used as a tool to enhance learning. The integration of these concepts were, for the most part, built around computer software packages which had been specifically designed to provide the availability of model building and simulation by students without the requirement of possessing a rigorous background in mathematics. Three examples of this type of software are: 1) MOSES (Modular Symbolic Electronic Simulation), 2) DYNAMO (Dynamic Modeling), and 3) STELLA (Structural Thinking Experimental Learning Laboratory).

Booker (1982) discusses the incorporation of DYNAMO as a System Dynamics modeling technique at Pace University and relates its beneficial contributions in helping students to mentally visualize the structure and process isomorphism inherent in all systems. Its principal use was in the MIS (Management Information Systems) curriculum.

Roberts, et el. (1983) addresses the development of a curriculum in System Dynamics that was designed to teach the System Dynamics methodology at an introductory level. This project was funded by a grant from the U. S. Office of Education and consisted of seven self-teaching learning packages. The latter three lessons required computer support in the DYNAMO simulation language. This program was field tested at both the graduate and undergraduate levels. Materials from these learning packages were also included in several sociology courses at Boston University. Results from

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the field-tests were favorable. However, like Booker's article, no quantifiable data or results measurement was included.

Shreckengost and Shreckengost (1983) discuss the teaching of System Dynamics at Nova, a nontraditional university. Its principal use was as a problem-solving technique used to analyze system structure and design. Again, as in previous examples, the implementation was accomplished through the use of DYNAMO.

Additional evidence of the potential use of System Dynamics as a learning tool is provided in a paper by Vescuso, ("Using STELLA to Create Learning Laboratories: An Example From Physics," International Conference of the System Dynamics Society, July 1985, Keystone, Colorado). Discussion centers around the use of STELLA to create simulation models for the purpose of teaching Physics. Richmond (1985) provides additional insights into the use of STELLA as a System Dynamics "expert system."

Eriksen and Nielsen (1985) discuss the development and use of MOSES, a hybrid computer designed to operate in conjunction with DYNAMO notation, at the Jutland Technological Institute at Aarhus, Denmark. Although the primary use of this system was to promote the application of System Dynamics modeling in Danish industry, it was also used to study economic models and methods from an academic perspective.

Of the many studies reviewed, DiStephano (1984) presents one of the few examples which uses the System Dynamics paradigm

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as a means for qualitative systems analysis. In her study entitled, "Focus On Feedback: Application Of System Dynamics To An Analysis Of The Dynamics Of Public Speaking," she identifies the factors needed for effective delivery of a prepared speech in a conversational manner, and the growth of the speakers' abilities over time. Emphasis is placed on variable relationships from a feedback perspective and requires no interface with computer software for purposes of model development. She relates that use of causal/influence feedback loops has motivated her to modify many of the teaching techniques which she had become accustomed to using, particularly in the area of encouraging more student feedback.

The latter part of this article addressed itself specifically to the need for more pretest and posttest measurement of learning results and enhancements that relate to System Dynamics use in a classroom environment. DiStephano feels that the need for more formalized measurement of results has reached the point of becoming an imperative if System Dynamics is to gain wider acceptance and application. It is to this very point that this research draws its focus - the development of quantifiable data on the effectiveness of qualitative System Dynamics methodology on learning results achievement.

Summary

Much of the literature reviewed supported the notion that System Dynamics has not yet become widely accepted within the

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academic community as a tool for the analysis and understanding of complex systems. Further, there is even less evidence to suggest that the paradigm has been used effectively by educational practitioners to communicate ideas through its incorporation into models for more effective teaching.

Perhaps the present dilemma of System Dynamics as a methodology is best described by Breiter (1985) in his article "Gaining Acceptance For A Systems Dynamics Model." He states:

> "In spite of the broad spectrum of potential applications and of a relative ease with which it is possible to communicate the contents of Systems' Dynamics models, as compared for example with linear programing models, the technique is slow in being widely accepted. It is used only in a few countries and then it is confined to isolated applications in spite of the fact that insights gained through study of behavior of modeled systems doubtlessly helps to make better decisions a wide variety of issues.
>
> Insufficient development of the Systems' Dynamics theory makes the success of its teaching highly dependent on the ability and perseverance of individual students to supplement this deficiency. Consequently, Systems Dynamics practical use has remained limited to those few who have mastered it through learning by trying, erring, sweating, and correcting. The others have either abandoned the efforts to use the technique or have produced poor results that made in fact the diffusion of Systems Dynamics difficult."

The very fact that System Dynamics has not been more widely used or accepted within the educational community as a means of increasing learning effectiveness may in part be directly linked to the lack of quantifiable data available in results. Practitioners in the field have attested to its successful use in educational applications through the use of various statements and claims. Many of the articles reviewed

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contained references to "meeting design objectives," and "more rapid improvement of skills," but did not attempt to provide proof to support these generalized conclusions.

These concerns were addressed by DiStefano (1984) in her study of the usage of System Dynamics to teach Public Speaking, when she stated: "In short, we need more objective tests to measure the success of the application of System Dynamics." Her point is well made as the literature review revealed little evidence of evaluation for purposes of quantifying and measuring effectiveness in the area of learning enhancement, particularly as it relates to the realm of qualitative uses.

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CHAPTER III

DESIGN OF THE STUDY

Setting For The Research

The proposed research for this study was conducted at New Hampshire College (NHC) in Manchester, New Hampshire. NHC is a small business college founded in 1932 by the late H.A.B. Shapiro. The school was awarded degree granting status in 1963 and received its initial accreditation in 1968 by the Northeast Association of Colleges and Secondary Schools. The full-time, day, undergraduate population has a normal enrollment range of fifteen to sixteen hundred students. At the present time, there are sixty-two full-time faculty members serving on the instructional staff; along with an adjunct faculty which fluctuates in size according to specialization needs.

In addition to the full-time, undergraduate, day college, a division of continuing education has been in existence since 1954. There are approximately three thousand students enrolled in eight centers which are located throughout New England and Puerto Rico.

New Hampshire College epitomizes the small non-profit institution which has emerged over the last 25 years in order to serve the needs of those individuals seeking a college degree in the field of Business Administration or related areas. At the present time, the average incoming freshman class is approximately 500 students with a 42% to 58% female to male ratio. The most frequently declared major is Business Administration which constitutes about 35% of the undergraduate

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enrollment. Finally, the student population at the college is predominantly white, middle-class, and comes from the New England region.

The Population

The population for this research project consisted of undergraduate students enrolled in the Personnel/Human Resource Management courses for the 1987 Fall semester. Intact classes and normal classroom settings were used to conduct this study and provided the researcher with a traditional quasi-experimental environment. All students were full-time, day school enrollees currently matriculated in one of the ten major areas of study offered at New Hampshire College. Each class contained 30 to 40 students with the female to male ratio being approximately 40% to 60%. For the most part, each class was comprised of sophomores and juniors with a few seniors in attendance. Two separate classes were used to conduct this research; one as a control group, and the other as an experimental group.

Sample And Sampling Procedures

The goal of most researchers is to use experimental designs which provide a maximum amount of control through the use of randomized sampling procedures. However, under certain circumstances--such as the educational research performed in this study using intact classes--it was impossible to make use of a true experimental design because full control over

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scheduling and the make up of individual classes could not be exercised. Because of this fact, the ability to develop a legitimate random sample of students was not available. However, random assignment of classes into control and experimental group status was accomplished by a coin flip after class rosters had been received.

Instrumentation

To obtain data essential for this study four separate instruments were used. The first, a standardized Critical Thinking Appraisal (CTA), was used to measure student's composite abilities and levels of competency in "critical thinking". The second, an objective test, was designed to examine student knowledge (Bloom's lowest learning order cognitive function) of the topic materials covered during the experiment. Third, a restricted response essay question test was constructed to measure student ability to analyze, synthesis, and evaluate information as identified with Bloom's higher order cognitive learning functions. The fourth and final instrument was a post-experimental survey questionnaire administered to those students who comprised the experimental group. This was done to provide both quantitative and qualitative data which could be used to evaluate affective responses to the System Dynamics teaching model.

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1. Critical Thinking Appraisal

The basic premise of this research project is that students who are taught using a model that incorporates the System Dynamics technique would show improved learning results over those who did not receive this treatment. It is the opinion of this researcher that enhanced learning is directly linked to improved "critical thinking" which as a construct, for the purpose of this study, has been interpreted to mean a greater ability to analyze, synthesize, and evaluate information. This interpretation was selected because it clearly met the objectives of this study and was consistent with the many definitions of this construct which are presently found in the literature on "critical thinking".

Both Watson and Glaser (1964), along with Ennis (1962), as the authors of the two most frequently used critical thinking appraisals, suggest that there are many definitions of this construct which are possible, and that considerable overlap exists among the many composite abilities which one might choose to identify as "critical thinking". For this reason, it was impossible to find an appraisal that exactly matched the specific meaning selected for use in this research.

Because of the need to establish some relative levels of student abilities in this area so that changes which might take place could be measured, it was necessary to select an evaluation instrument. The Watson-Glaser Critical Thinking Appraisal was chosen by this researcher for two specific reasons. First, it was the most frequently used appraisal in

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the literature reviewed which dealt with the measurement of "critical thinking". Second, the test format consisted of five seperate areas that were judged to be compatable with the task of measuring higher order learning in students. These areas were: inference, recognition of assumptions, deduction, interpretation, and evaluation.

a. Reliability: The internal reliability and consistency of the Watson-Glaser appraisal has been assessed by its authors in several ways. Internal consistency was measured by calculating split-half reliability coefficients which were correlated for test length using the Spearman-Brown prophecy formula. The coefficients ranged from .69 to .85.

b. Content Validity: The content validity of a test is not an attribute that can be described by a single study or isolated correlation coefficient. It is a joint characteristic of the test and the purpose for which is being used. In examining the test's content validity, it should be noted that there is no general agreement on the definition of "critical thinking". However, within each instructional setting where teachers attempt to develop or measure the "critical thinking" abilities of their students, there is a contextual framework from which teachers must work. In this research project, Bloom's higher order learning objectives (as previously stated)

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are considered to be compatable with the criteria used by Watson and Glaser to measure "critical thinking" as it relates to knowledge and skills.

c. Construct Validity: Instructional settings were used by Watson-Glaser to establish the construct validity of their CTA. (e.g. They state that Sorenson (1966), for example, found that participants in laboratory centered Biology classes showed greater change in CTA scores than members of classes where the teaching method was predominantly a traditional lecture approach.)

d. Application: The Watson-Glaser Critical Thinking Appraisal was administered to both the control and experimental groups in a pretest/posttest format. Form (A) was used as a pretest and given during the second week of class. This was done prior to the start of any experimental treatments. Form (B) was given as a posttest one week after experimental treatments had been concluded. The pretest was also used to identify any differences which might exist in students "critical thinking" abilities. Both examinations were given in a normal classroom environment during regularly scheduled class periods. Each form contained 80 questions and students were given 60 minutes to complete the assigned tasks.

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2. Objective Examination

The objective examination was administered for the purpose of measuring student knowledge as it pertained to the subject materials covered during the experiment. As mentioned earlier, knowledge is defined by Bloom (1974) as the lowest order learning objective. For this reason, the objective test consisted solely of multiple-choice questions. (See Appendix: F, Part I)

a. Reliability: Because this test (like the Watson-Glaser) was given in a pretest/posttest format, I was able to use a split-half reliability coefficient for purposes of checking internal consistency before administering the posttest. TABLE 1, shown below, reports the results of that analysis.

TABLE 1

Split-Half Correlation Of Objective Pretest (N=66)

	Objective Pretest (C + E1)		Objective Pretest (C + E1)	
	Odd-Correct	Even-Correct	Odd-Incorrect	Even-Incorrect
Item	1-49	2-50	1-49	2-50
Cases	25	25	25	25
Mean	31.72	34.64	34.68	31.36
Std D.	13.51	13.74	13.49	13.74
Pearson r	.3668		.3707	
Spearman Brown	.536		.541	

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The correlation coefficients between the two halves of .536 and .541 indicate that a reasonable degree of internal consistency exists. Ary et al. (1979) suggest that if scores are obtained for individual halves of an examination, and a coefficient correlation is calculated for the two scores, when each subject has a very similar position on the two halves, the test has high reliability.

b. Content Validity: The questions constructed for purposes of evaluating student knowledge were subjected to criteria based on effective test design and content material relevancy. Questions were developed using appropriate principles and procedures recommended in textbooks on test design. These were: Measurement and Evaluation In Teaching by Norman E. Gronlund (1971), and Evaluation In Psychology and Education by Robert L. Thorndike and Elizabeth P. Hagen (1977). (See Appendix: G, Section A) These same questions were also mapped directly onto the content materials assigned for study during the experiment. (See Appendix: H)

The last 10 questions on the examination were excerpted directly from a practice test generated by the Personnel Accreditation Institute (PAI) and used by them to certify Human Resource Professionals. These questions were identified by this researcher as being related to the

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topic materials assigned students for study during this project.

Finally, the examination in its completed format was reviewed by two colleagues, Dr. Robert Losik and Professor Irving Rothman, for content.

c. Application: The objective knowledge test contained 50 multiple-choice questions and was administered to both control and experimental groups in a pretest/posttest format. The pretest application was used to check the homogeneity of groups as it related to prior knowledge of subject materials being covered in this research. Posttest results were used to measure possible learning enhancements. The pretest application of this examination was given in the class immediately preceding the start of experimental treatments. The posttest was administered in the class immediately following experimental treatments. Both examinations were conducted in a normal classroom environment and students were given 30 minutes to complete the assigned tasks.

3. Restricted Response Essay Examination

The restricted response essay examination, like the objective examination, was administered for the purpose of measuring student knowledge of subject materials covered during this project. The essay question was chosen because it provides a direct measure of complex learning outcomes which can not be

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measured by other means, as well as, giving emphasis to the integration and application of learning outcomes that deal with student's abilities to select, organize, integrate, and evaluate ideas. The test was explicitly designed to explore and evaluate Bloom's taxonomy dealing with higher order cognitive learning; specifically, the analysis, synthesis, and evaluation of information. Because this exercise required students to use their writing skills, a writing exercise was conducted during the first week of class in order to procure a sample from each student. These samples were given to a member of the English Department for evaluation along with a writing score sheet and a set of instructions for its use. (See Appendix: I) The writing sample scoring criteria and scoring sheet were adapted from Paul Diederick's (1974) studies on measuring English competency. This was done in order to ascertain if either the control or experimental groups had a competitive advantage in responding to the essay question.

a. Reliability: Essay questions have the inherent property of relatively low reliability with respect to consistent and equitable application of scoring criteria. This is principally because of the subjective variation found within and among readers. This point is specifically noted by Gronlund (1971), Thondike (1977), Ennis (1984), et al. In order to address this problem, and to insure the maximum amount of scoring reliability possible, an approach to grading essay questions was developed that

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includes a Likert-type scale and scoring sheet. The intent of this approach was to minimize errors of inconsistency and inaccuracy in the evaluation process. (See Appendix: J)

b. Content Validity: As was the case with the objective examination, careful consideration was given to the construction of the restricted response essay question. Again, appropriate design principles and procedures were used in their development in order to require students to "think critically" (analyze, synthesize, and evaluate) about the information required for answering. (See Appendix: G, Section B) These questions were also carefully mapped onto the materials assigned for study. (See Appendix: H)

d. Application: The restricted response essay question was given to both control and experimental groups in a posttest format only. It consisted of one question that required four separate parts to be answered. This essay examination was given immediately after the objective posttest and during the same class period. Students were allowed 50 minutes to complete this task. (See Appendix: F, Part II)

The students involved in this research project were not aware that their class was being used for purposes of gathering

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research data. Each individual was assigned a code number to insure their anonymity during the scoring of all examinations. This was done to avoid any halo or familiarity effects which might possibly occur in the grading of papers.

Study Design And Statistical Considerations

The study design used in this research project was of the quasi-experimental variety described in Campbell and Stanley (1961). Three separate parametric statistical treatments were used in conjunction with this approach to explore relationships established between the independent and dependent variables under observation.

First, a t-test of independent sample means was conducted for each of the independent variables. This included the grade point average, writing skills, pretest knowledge of subject materials, and critical thinking ability scores of the student populations in both the control and experimental groups. This test was conducted using the assumption that the null (H_0) hypothesis was true and no significant differences existed between the control and experimental groups. A probability level of .05 was selected as appropriate to fail to reject the H_0 hypothesis. The principal reason for using the t-test was to ascertain the degree of similarity or homogeneity present between the two groups prior to System Dynamics treatment applications.

The second statistical treatment used was a multiple regression analysis of the independent variables, grade point

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average (GPA), writing skills (W-SAMP), objective pretest (O-PRE-T), and critical thinking ability (CTA-A) on the dependent variables, objective posttest (O-PT-T), objective posttest using "next best answer" analysis (NBA), and restricted response essay question (RRE). This was done in order to identify levels of t-significance which could then be used to indicate the strength of association between the independent and dependent variables. Specifically, to establish a legitimacy of the independent variables chosen as covariants in hypothesis testing and to indicate their possible value as predictors for success ratio levels in future experiments involving the use of System Dynamics technique.

Using the standard regression equation ($Y = a + b_1x_1 + b_2x_2...$) for this analysis, the constant (a) represents the control group. A significant-t level of $P < .05$ was chosen to indicate whether the independent variables contributed something to the understanding of the dependent variable (Y) with all others held constant. For purposes of identification, both the control and experimental groups used dummy coding procedures. The experimental being (D = 1), and the control group being (D = 0).

The third consideration was the application of ANOVA or Multiple Analysis of Variance for hypothesis testing. A nonrandomized control group pretest - posttest design as outlined in Campbell and Stanley (1961) was used to measure any changes which might have occurred to the experimental group after having received the teaching model. In this design (See

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Figure 1 below), O_1 and O_3 represent the pretest measurements of control and experimental groups. X_1 represents the intervening independent variable - the use of System Dynamics as a teaching methodology - to experimental group E1. O_2, and O_4 represent the posttest scores of control and experimental groups.

FIGURE 1

Campbell and Stanley Quasi-experimental Design

Group Control OR Experimental	Pretest Observation Y_1	Ind.Var X_1 (Using S.D. as a Teaching Methodology)	Posttest Observation Y_2
C	O_1	-	O_2
E1	O_3	X_1	O_4

The utilization of ANOVA techniques for the purpose of obtaining the F-ratio statistic was used to identify significance levels.

The final instrument used to evaluate study results was a survey developed by this researcher. Basic design principles were incorporated from E. F. Babbie's book, Survey Research Methods, published in 1973. This survey was administered after all testing had been completed and only to those students who were part of the experimental group. Its purpose was to provide them with an opportunity to express their feelings about the experience, and to facilitate qualitative, as well

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as, quantitative results evaluation. (See Appendix: L, Survey Questionnaire)

A. Hypothesis Number One

An analysis of covariance was performed on pretest and posttest data gathered from the evaluation instruments with the resulting F-ratio statistic being used to measure significance at the $P < .05$ level as a means of hypothsis testing. Pretest covariants were determined by the independent variable strength of association with the dependent variable as identified through the significant-t levels that were obtained in the aforementioned multiple regression analysis. This application was performed on both parts of the hypothesis.

B. Hypothesis Number Two

As with hypothesis number one, an analysis of covariance was performed on pretest and posttest data with the resulting F-ratio statistic being used to measure treatment effect at the $P < .05$ significance level. Pretest covariants were again determined by the significant-t levels derived through multiple regression.

C. Hypothesis Number Three

A simple analysis of variance was performed on the posttest data gathered from evaluation instruments designed to measure critical thinking. The posttest CTA

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(Form B) was used to compare results. The F-ratio statistic was again used to measure treatment effect at the $P < .05$ significance level.

Independent Variables

Four independent variables were identified as being meaningful in this study for purposes of control and relationship measurement to the dependent variables. (See list below) Important questions dealing with levels of group homogeneity, and "predictor" value of group attribute characteristics, could only be addressed and ascertained by their inclusion in the research design. Three of these variables are of the attribute variety and as such could reasonably be expected to exhibit relationship or predictor characteristics that would provide valuable insight into meaningful results interpretation. The other, an intervening variable, has at least a theoretical relationship, or affect, on any observed changes which might occur. However, it is difficult to measure with high levels of precision because effects must be inferred from the affects of the independent variables on the observed phenomena of dependent variable changes.

Attribute Variables:

1. Grade Point Average(GPA)--It is reasonable to expect that demonstrated scholastic achievement of students within the control and experimental groups would have an

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effect on their examination results. Students with higher GPA's would be expected to perform better on pretest and posttest. For this reason, the similarity/homogeneity of groups was evaluated through the use of students scholastic files. These files were used to procure data for the purpose of grade point average comparison.

2. Writing Ability--Because part of this project required students to use writing skills in answering an essay question, it was necessary to identify if any competitive advantage in this area was possessed by either the control or experimental groups. For this reason, it was required that groups be tested for homogeneity. A writing sample was conducted for this purpose.

3. Prior Subject Knowledge--The question of controlling for, or identifying, unfair competitive advantage was again addressed by measuring preexperimental levels of student knowledge on the subject materials covered during the research. An objective pretest was administered to both control and experimental groups.

Intervening Variable:

4. Critical Thinking Ability--As defined in the Description Of Terms section in this report, "critical thinking" is used to mean the ability to analyze, synthesize, and evaluate information for the purpose of formulating

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correct answers. A standardized critical thinking appraisal was administered in a pretest format to both control and experimental groups to ascertain similarity of student skills as they related to this construct.

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CHAPTER IV

RESULTS AND DISCUSSION

Introduction

The purpose of this research study was to investigate the effects of using a specially designed teaching model--one that incorporated System Dynamics application--as a way to enhance student learning in the discipline of management studies; specifically, the field of Human Resource Management. A total of 67 students took part in this investigation and represented two undergraduate sections of ADB211. The raw data which was gathered may be found in the appendices section of this report. (See Appendix: K)

Control and Experimental Group Comparison of Attribute and Intervening Independent Variables

In order to identify the degree of similarity which existed between the control and experimental groups, the first statistical analysis performed on the raw data was a t-test comparison of the mean scores on each of the four independent variables. It was hypothesized that no difference was present and that both groups were similar in composition. A significance level of .05 was chosen as appropriate to fail to reject the null (H_0) hypothesis. TABLES 2 through 5, shown below, report the following results:

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TABLE 2

Grade Point Average (GPA) Comparison of the Control and Experimental Groups (hypothesized difference: 0)

Groups (N=67)	N	MEAN	S.D.	t	p
Control (C)	32	2.63	.51	-.22	.676
Exper. (E1)	35	2.66	.60		

TABLE 3

Writing Sample Score (W-SAMP) Comparison of the Control and Experimental Groups (hypothesized difference: 0)

Groups (N=67)	N	MEAN	S.D.	t	p
Control (C)	32	34.43	9.08	-.87	.392
Exper. (E1)	35	36.45	9.86		

TABLE 4

Objective Pretest Score (O-PRE-T) Comparison of the Control and Experimental Groups (hypothesized difference: 0)

Groups (N=67)	N	MEAN	S.D.	t	p
Control (C)	32	51.87	9.42	.80	.430
Exper. (E1)	35	50.00	9.65		

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TABLE 5

Critical Thinking Appraisal Score (CTA)
Comparison of the Control and Experimental Groups
(hypothesized difference: 0)

Groups (N=67)	N	MEAN	S.D.	t	p
Control (C)	32	53.87	7.76	-1.25	.212
Exper. (E1)	35	56.34	8.30		

Results: Failure to reject the null hypothesis at the .05 level indicates that no significant differences exist between the control and experimental groups on grade point average, writing skills, pretest knowledge of subject materials, or critical thinking abilities.

Discussion: An examination of the probability levels associated with t-values revealed a reletively low probability of .212 on the critical thinking appraisal to a high probability of .676 on the grade point average. Each of the attribute variable scores: grade point average .676, writing sample .392, and objective pretest of knowledge .430, were well above the .05 level needed to reject the null hypothesis. The standard deviation scores for each group were revealed to be quite high. It is possible that this is a reflection of the disparate ability levels of New Hampshire College students and simply reflects enrollment criteria which are not selective.

Finally, it is interesting to note that the intervening

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variable identified as critical thinking showed the least amount of similarity between groups.

Multiple Regression Coefficient Analysis of Independent and Dependent Variables

A multiple regression analysis was performed to identify the strength of the relationships among the variables used in this study. As such, its intended purpose was to help establish a legitimacy for the selection and use of independent variables as covariants in hypothesis testing. TABLE 6, shown below, reports the correlation coefficients.

TABLE 6

Correlation Matrix of Independent and Dependent Variables

	INDEPENDENT VARIABLES				DEPENDENT VARIABLES			
	GPA	W-SAMP	CTA(A)	O-PRE-T	O-PT-T	NBA	RRE	CTA(B)
GPA	1.000	.131	.351	.264	.640	.561	.332	.327
W-SAMP	.131	1.000	.326	.285	.317	.416	.194	.354
CTA(A)	.351	.326	1.000	.488	.257	.292	.397	.251
O-PRE-T	.264	.285	.488	1.000	.397	.368	.379	.212
O-PT-T	.640	.317	.257	.397	1.000	.923	.488	.309
NBA	.561	.416	.292	.368	.923	1.000	.541	.234
RRE	.332	.194	.397	.379	.488	.541	1.000	.226
CTA(B)	.327	.354	.251	.212	.309	.234	.226	1.000

Discussion: One of the principal attributes associated with correlation coefficient analysis is its ability to ascribe a realistic level of association between the variables under

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study. In this case, it was revealed that the independent variables selected as being important to this research did show a relatively strong relationship to the dependent variables under observation. Two areas in particular showed a high degree of correlation between themselves and the dependent variable category. These were: 1) the grade point average, and 2) objective pretest of knowledge. This did not come as a surprise since both demonstrated performance (as reflected through prior academic achievements) and pretest knowledge of subject material have traditionally been used as "predictors" in educational research designed to investigate results of treatment applications.

The writing sample coefficients did prove to be interesting, if not enigmatic. Reasonable correlations of .317 and .416 were shown between the writing sample and the dependent variables objective pretest and objective posttest using "next best answer" analysis. However, the coefficient dropped to .194 when tested against restricted response essay results. One would normally be inclined to associate writing skills with an ability to do well on essay questions. It must be remembered that the essay portion of the evaluation of System Dynamics treatment effects on enhanced learning was designed specifically to measure the quality of response from a content perspective and not from a writing skills perspective. Therefore, although writing skills may be helpful in such areas as grammatical and syntactical correctness of answer construction, they do not impact on the correctness of content.

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Further, the specific instructions for scoring the restricted response essay question prohibited the use of punctuation or writing style from consideration in the grading process. (See Appendix: J)

Another note of interest was the fact that correlation coefficients between grade point average and objective posttest results .640 and .561 were approximately twice that of the coefficient between grade point average and restricted response essay .332. This would tend to substantiate the belief that in some way (at least for this population) students will typically achieve higher test scores in circumstances that foster the short term memorization of facts for testing accommodation; rather than requiring the use of higher order cognitive functions such as analysis, synthesis, and evaluation of data for purposes of appropriate answer development.

The lowest set of correlational coefficients was found to exist between the independent, intervening variable critical thinking appraisal and the dependent variables. However, the largest coefficient for this group was identified as the relationship between critical thinking appraisal and restricted response essay results at a .397 level. This might suggest that to the extent commercially available CTA's do, in fact, measure a students ability to use higher order cognitive skills; and those skills are transferable to requirements for processing information presented in the teaching model used in this experiment, they could have some limited value as predictors.

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Finally, the correlation coefficient matrix does identify the fact that independent variables used in this study correlate (as they should) more positively with the dependent variables than they do with themselves. This serves to strengthen the justification of their use in this study.

Multiple Regression Analysis of Independent Variables to the Dependent Variable: Objective Posttest

A multiple regression analysis was performed on the dependent variable, objective posttest, and the independent variables used in this research project. This was done to identify the amount of variation in (Y) that could be assigned to the independent variables and to indicate the strength of individual variable association through Beta coefficients. GRP1 is used as a qualitative, independent variable for the purpose of "breaking groups" in order to more precisely identify treatment effects. TABLE 7, shown below, reports the following results:

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TABLE 7

Beta Coefficients of Independent Variables Measured Against the Dependent Variable--Objective Posttest

MULTIPLE R	.736
R SQUARE	.542
ADJUSTED R SQ.	.505
STD.ERROR	.095

IND. VARIABLE	B	STD. ERROR B	BETA	SIG. t
CTA(A)	-0.235	.134	-0.188	.084
GRP1	3.678	1.801	.183	.045*
W-SAMP	0.209	0.009	.197	.038*
GPA	10.814	1.582	.598	.001*
O-PRE-T	0.310	0.109	.292	.006*
CONSTANT	30.694	6.752		

*Significant @ .05 level

Results: The multiple coefficient of correlation R was .736 and the coefficient of determination R^2 was .542. Beta coefficients for the independent variables chosen for evaluation were all significant at the .05 level with the exception of the critical thinking appraisal which fell just outside of the acceptable range.

Discussion: The multiple R value of .736 indicates that there is a high degree, or strength, of relationship between the dependent variable objective posttest and the independent variables. The R^2 value of .542 shows the amount of this association (or variation in Y) which may be assigned to the independent variables. The level of t-significance identifies grade point average as having the greatest impact on any

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changes in Y; while the level of t-significance of critical thinking appraisal identifies it as having the least amount of impact.

To the extent that all of the independent variables (with the exception of the critical thinking appraisal) are significant at the .05 level, one can state that each contributes significantly to the understanding of Y. "It is implicit that such measurements of contribution are made with all other variables in the regression equation held constant." Given this data, the independent variables: 1) grade point average, 2) objective pretest of knowledge, and 3) writing sample were all selected as legitimate covariates for hypothesis testing of objective posttest results. It also suggests some additional merit for their use as predictors in future studies of this nature.

The independent variable GRP1 was used as a means of "breaking groups" for the purpose of identifying treatment effects on the experimental group. As such, its Beta coefficient of 3.678 and significant-t of .045 indicated that changes in posttest scores were affected by being in the experimental group.

Multiple Regression Analysis of Independent Variables to the Dependent Variable: Objective Posttest using "next best answer"

A second multiple regression analysis was performed on the dependent variable, objective posttest (using the "next best

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answer" as an expanded criteria for measurement of test results), and the independent variables used in this research. Again, this was done to identify the amount of variation in (Y) that could be assigned to the independent variables, and to signify the strength of individual variable associations. TABLE 8, shown below, reports the following results:

TABLE 8

Beta Coefficients of Independent Variables Measured Against the Dependent Variable--Objective Posttest Using the "Next Best" Answer

MULTIPLE R	.723
R SQUARE	.523
ADJUSTED R SQ.	.484
STD. ERROR	.072

IND. VARIABLE	B	STD. ERROR B	BETA	SIG. t
CTA(A)	-.148	.144	-.141	.201
GRP1	4.455	1.451	.265	.005*
W-SAMP	.266	.084	.298	.002*
GPA	7.562	.440	.498	.001*
O-PRE-T	0.218	.093	.246	.020*
CONSTANT	43.633	5.779		

*Significant @ .05 level

Results: The multiple coefficient of correlation R was .723 and the coefficient of determination R^2 was .523. As with the previous test, the Beta coefficients for the independent variables were all significant at the .05 level with the same exception of the critical thinking appraisal. It again fell outside of the acceptable range.

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Discussion: As before, the multiple R of .723 indicates a high degree of relationship between the dependent variable, objective posttest (using "next best" answers), and the independent variables chosen for this study. The R^2 of .523, once again, indicates that a notable percentage of the variance in (Y) is associated with the independent variables. The level of t-significance identifies grade point average as having the most impact on changes in (Y), and critical thinking appraisal's level of t-significance as having the least. A GRP1 significant-t of .005 indicates that the research treatment had a significant affect on the scores of the experimental group.

The results of this regression equation, and the previous one, were very similar. This was not altogether unexpected given the fact that one was merely a modification of the other as it related to objective answer interpretation.

For a second time, one could safely say that all of the independent variables (with the exception of critical thinking appraisal) fell within the acceptable significant-t range of .05, and that each contributes significantly to the understanding of (Y). As in the previous regression analysis, the independent variables: 1) grade point average, 2) objective pretest of knowledge, and 3) writing samples were all selected as legitimate covariates for hypothesis testing of the objective posttest (using "next best" answer) results.

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Multiple Regression Analysis of Independent Variables to the Dependent Variables: Restricted Response Essay

Finally, a third regression analysis was performed on the dependent variable, restricted response essay examination, and the aforementioned independent variables. As with the previous examples, this was done to identify the variation in (Y) that could be assigned to the independent variables. TABLE 9, shown below, reports the following results:

TABLE 9

Beta Coefficients of Independent Variables Measured Against the Dependent Variable--Restricted Response Essay

MULTIPLE R	.618
R SQUARE	.382
ADJUSTED R SQ.	.332
STD. ERROR	3.081

IND. VARIABLE	B	STD. ERROR B	BETA	SIG. t
CTA(A)	.054	.058	.116	.355
GRP1	2.963	.782	.395	.001*
W-SAMP	-.347	.043	-.873	.993
GPA	1.345	.730	.199	.070
O-PRE-T	.122	.047	.308	.010*
CONSTANT	2.427	2.932		

*Significant @ .05 level

Results: The multiple coefficient of correlation R was .618 and the coefficient of determination R^2 was .382. Unlike the previous tests, the Beta coefficients for the independent variables identified not only the critical thinking appraisal

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as failing to reach the significance level of .05, but also two other attribute variables. These were: 1) grade point average, and 2) writing sample. However, both the independent variable (GRP1), and the objective pretest did fall within the acceptable range.

Discussion: Again, the multiple R of .618 indicated a high degree of relationship between the dependent variable, restricted response essay test, and the independent variables. However, this level of association was considerably less than the previous regressions. Consistent with this result was the commensurate decline in the value of R^2 to .382 as an indication of the amount of variation in (Y) attributable to the independent variable interactions. The most significant Beta coefficient belonged to the qualitative variable GRP1. This was of particular importance since GRP1 was used to break groups for the purpose of identifying System Dynamics treatment effects on the experimental group. To this end, a Beta of 2.963 with a significant-*t* of .001 provides support for the hypothesis that treatment does make a difference. In this case, more identification of association is found to exist between the control and experimental groups rather than the pre-experimental attribute variables.

Of the three attribute variables tested, only the objective pretest was capable of a significant-*t* value at or below the .05 level; and as such, it was selected as one of two covariants for hypothesis testing of the restricted response

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essay examination. Grade point average was also selected as a covariant because it was identified as being significant at the .07 level and had exhibited the strongest levels of significance in the two previous regressions.

Hypothesis Testing

Hypothesis Number One:

Undergraduate college students who participate in a learning environment which used a teaching model that incorporates System Dynamics analysis technique as a strategy for learning enhancement will:

(PART 1) score higher on objective examinations designed to test their knowledge of Human Resource Management, than students not receiving this model.

(PART 2) have a greater ability to identify the "next best" correct answer, when they get the question wrong, than students not receiving the model.

An Analysis of Covariance using multiple covariates (as discussed in the preceding section) was applied as a statistical treatment for purposes of measuring change between control and experimental groups. This change is represented by the F-ratio. The .05 level of significance was chosen as appropriate for rejection of the null hypothesis. TABLES 10, 11, 12, and 13, shown below, report the following results:

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TABLE 10

Variable Mean Scores--Objective Test
(Part 1: Correct answer only)

GROUP	MEASURE	PRETEST (COVAR)	POSTTEST
Control (N=32)	Grade Point Ave.	2.639	
	Writing Sample	34.437	
	Subject Knowledge	51.875	69.875
Exper. E1 (N=35)	Grade Point Ave.	2.669	
	Writing Sample	36.457	
	Subject Knowledge	50.000	73.142

TABLE 11

Analysis of Covariance--Objective Test
(Part 1: Correct answer only)

SOURCE OF VARIATION	DF	SS	F-RATIO	SIG.
Between Groups	1	149.43	2.87	* An F-Ratio of 3.99 with 65 DF needed to reject H_0 @ P < .05 level.
Within Groups	62	3225.66		
TOTAL	66	3375.01		

(*Results not significant at the .05 level)

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TABLE 12

Variable Mean Scores--Objective Test
(Part 2: Using correct and "next best" answers)

GROUP	MEASURE	PRETEST (COVAR)	POSTTEST
Control (N=32)	Grade Point Ave.	2.639	
	Writing Sample	34.437	
	Subject Knowledge	51.875	76.125
Exper. E1 (N=35)	Grade Point Ave.	2.669	
	Writing Sample	36.457	
	Subject Knowledge	50.000	80.571

TABLE 13

Analysis of Covariance--Objective Test
(Part 2: Using correct and "next best" answers)

SOURCE OF VARIATION	DF	SS	F-RATIO	SIG.
Between Groups	1	265.71	7.12	* An F-Ratio of 3.99 with 65 DF needed reject H_0 @ P < .05 level.
Within Groups	62	2310.93		
TOTAL	66	2576.64		

(*Results are significant at the .05 level)

Results: In (Part 1) of this hypothesis, the F-ratio score of 2.87 was found insufficient to reject the null hypothesis at the .05 level. Therefore, we may state that the treatment

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model did not have sufficient impact on the experimental group to cause enhanced learning to take place. In (Part 2), the F-ratio score was identified as 7.12 which was sufficient to reject the null hypothesis at the .05 level. As such, we may assume that the treatment model had a significant effect on the experimental groups ability to more effectively identify and select the "next best" answer in those cases where their original choice was incorrect.

Discussion: The results of covariance testing on Parts (1) and (2) of this hypothesis were extremely interesting. The strict and traditional interpretation of their being only "one" correct answer on an objective test showed that the treatment did not have any significant effect on learning outcome. Although disappointing, this was not entirely without expectation. It is the feeling of this researcher that in all probability, two major considerations contributed to this lack of impact. First, the time available for treatment application was in all likelihood too short in duration to have been meaningful; and secondly, the treatment model was designed to enhance, the higher order, rather than lower order, cognitive domain activity. Bloom (1974) feels that the objective question, as a means of knowledge testing, inherently does not evoke the student to engage in analysis, synthesis, and evaluation activities (at least not overtly) because the questions themselves are designed to emphasize the remembering

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of information, either by recall of ideas, materials, or phenomena.

Part (2) of the tested hypothesis did yield results significant at the .05 level. It is important to note that the System Dynamics treatment received by the experimental group did emphasize an approach that continually required the reevaluation and assessment of subject material content in search of causal or influence relationships. To the extent that this exercise became inculcated into a student's mode of processing information, it might have influenced (and thus explained) the improvement of the experimental group results over those of the control group.

The experimental group students, in all probability, were more deliberate in their focus on finding the correct answer. As such, they would be more likely to select the "next best answer" (a highly "positive" detractor) that showed a closer relationship to the correct answer. These results would seem to indicate that some sort of carry-over effect from System Dynamics analysis activities could have caused students to engage in a more deliberate search to find the right answer when they were uncertain as to what the correct answer was.

Hypothesis Number Two:

Undergraduate college students who participate in a learning environment which used a teaching model that incorporates the System Dynamics analysis technique as part of a strategy for learning enhancement will score higher on an

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essay examination designed to engender the higher order cognitive domain functions of analysis, synthesis, and evaluation, than students not receiving this model.

Once again, an analysis of covariance using multiple covariates was applied as a statistical treatment to investigate any change which might have taken place in the area of enhanced learning between the control and experimental groups. This change being measured by the F-ratio score. As before, the .05 level of significance was chosen to be appropriate for rejection of the null hypothesis. TABLES 14 and 15, shown below, report the following results:

TABLE 14

Variable Mean Score--Restricted Response Essay

GROUP	MEASURE	PRETEST (COVAR)	POSTTEST
Control (N=32)	Grade Point Ave.	2.639	
	Subject Knowledge	51.875	
	Rest. Resp. Essay		15.23
Exper E1 (N=35)	Grade Point Ave.	2.669	
	Writing Sample	50.000	
	Rest. Resp. Essay		18.14

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TABLE 15

Analysis of Covariance--Restricted Response Essay

SOURCE OF VARIATION	DF	SS	F-RATIO	SIG.
Between Groups	1	161.65	17.33 *	An F-ratio of 3.99 with 65 DF needed to reject H_0 @ P < .05 level.
Within Groups	63	587.61		
TOTAL	66	749.26		

(*Results are significant at the .05 level)

Results: The F-ratio score for this test was found to be 17.33 which is sufficient to not only reject the null hypothesis at the .05 level, but at and beyond the .01 probability. Therefore, we may state that the treatment had a significant impact on the results of experimental group performance as related to restricted response essay evaluations.

Discussion: The difference between the two groups on essay test scores was larger than expected. Although the teaching model used in this research project was specifically designed to facilitate the enhancement of higher order cognitive functions, this researcher was surprised at the level of significance achieved.

Prior to the application of covariance analysis, a random sample of 10 papers (5 from each group) was drawn and submitted to Dr. Robert Losik (a colleague who teachers Human Resource

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Management) for his evaluation and scoring. This represented a 15% sample of the total essays corrected. The purpose of this activity was to provide a check on (and hopefully corroborate) the consistency of scoring applications. TABLES 16 and 17, shown below, report the following results:

TABLE 16

Comparative Sample Scores--Restricted Response Essay
(hypothesized difference: 0)

SAMPLE	N	MEAN	S.D.	t	p
EVANS	10	15.25	4.23	.373	.674
LOSIK	10	14.55	4.15		

*Fail to reject H_0 @ .05 level

TABLE 17

Spearman-Rho Rank Correlation--Restricted Response Essay

ITEM	SCORE EVANS	RANK	SCORE LOSIK	RANK
1	21	9	18	8.5
2	8	1	7.5	1
3	16.5	7	17	7
4	17	8	18	8.5
5	13	3.5	13.5	4
6	16	6	14.5	5
7	14.5	5	16	6
8	22	10	20.5	10
9	13	3.5	10	2
10	11.5	2	10.5	3

(Rho = .963 with P < .001)

This comparison revealed a Spearman-rho correlation of .963 between the scores derived by Dr. Losik and those that

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were generated by this researcher. The null hypothesis was rejected at .05 level and beyond. This "quality assurance" check would seem to indicate that examination evaluation was free from any bias which could have influenced results.

In this researcher's opinion, there were several factors which conjoined to contribute to this significant difference between groups. The procedures that were followed during the application of the teaching model required that students pay full attention to all classroom activities. Most of what was taking place did not fall into the category of a traditional lecture, and because of this, required constant participation on the student's part. The exercises which were designed to help develop a dynamic perspective of the materials under study, in all probability, served to increase their span of attention as well as heighten their in-class anxiety. As a result, this caused more focus on the learning activities that were taking place. The students, (because of their exposure to System Dynamics) had become more keenly aware of the relationships of the various parts of a system and how each part influenced the other; an awareness which permitted them to process in-class information more thoroughly when called upon to do so in a learning evaluation exercise such as the essay question.

As a population, the experimental group, had not only been exposed to new and unfamiliar in-class techniques, but were required to increase their level of participation during class sessions. Both the classroom and homework assignments

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encouraged them to seek ideas and input from other students as part of the modeling process.

Kraft (1983) reported that the National Institute of Education convened a Study Group on the Condition of Excellence in American Higher Education, and their reports insists: "that students are more apt to learn content if they are already actively engaged in it." It further stated that: "the lecture dominates higher education and is often defended, mostly because professors have never seen successful alternatives." Eighteen years earlier, Gotesky (1965) had mused over what he perceived to be an obvious fact: "that the classroom lecture is not only here to stay; it is likely to be used more widely and extensively than ever before. And if it is here to stay, then the question: Must the lecture remain essentially an instrument of rote learning or can it be transformed into an instrument for developing critical thinking?"

This researcher believes that the use of in-class techniques which foster analytical modes of subject material investigation, and make the logical progression from linear to dynamic interaction in the relationship between variables, is a step in the right direction. A step that will help make the classroom a better vehicle in which to transport knowledge from the instructor to the student and thus; hopefully, bring about more effective learning.

While discussing the myth of critical thinking, Skinner (1972), states that: "The evaluation of courses is too often based upon subject material recall and not upon the process of

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critical thinking. Most teachers would flatly deny that their goal of teaching was fact giving, but upon observation of their examinations it is clear that many demand only facts."

Stonewater and Stonewater (1984) suggest that instructional strategies which facilitate cognitive development can be categorized into two groups: 1) instruction that challenges the students cognitive structures, or creates disequilibrium, and 2) instruction that provides support such that the student will "engage" in the opportunity created by the disequilibrium. The System Dynamics approach used in this research project to deliver course content material did in fact create a type of disequilibrium. A new focus on how to learn through the use of system modeling was introduced, with it cause/effect and action/reaction relationships. Facts were no longer to be memorized; information was to be processed in a rational mode.

Hypothesis Number Three:

Undergraduate college students who participate in a learning environment which uses a teaching model that incorporates System Dynamics analysis technique as part of a strategy for learning enhancement will score higher on the Watson-Glaser Critical Thinking Appraisal designed specifically to measure student critical thinking abilities in the areas of inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments, than students not receiving the model.

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This final hypothesis was tested using a simple analysis of variance (ANOVA) as the statistical treatment. Unlike the previous two cases, pretest covariates were not used. Changes between the control and experimental groups were, as before, measured through the use of the F-ratio with a .05 level of significance chosen as appropriate for rejection of the null hypothesis. TABLES 18 and 19, as shown below, report the following results:

TABLE 18

Variable Mean Scores--Critical Thinking Appraisal (Form B)

GROUP	MEASURE	POSTTEST
Control (N=28)	Critical Thinking Appraisal (B)	54.25
Exper E1 (N=30)	Critical Thinking Appraisal (B)	56.43

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TABLE 19

Analysis of Variance--Critical Thinking Appraisal (Form B)

SOURCE OF VARIATION	DF	SS	F-RATIO	SIG.
Between Groups	1	69.03	1.13 *	An F-ratio of 4.02 with 55 DF needed to reject H_0 @ $P < .05$ level.
Within Groups	56	3408.61		
TOTAL	57	3477.64		

(*Results not significant at the .05 level)

Results: The F-ratio score for this ANOVA was found to be 1.13 which was not sufficient to reject the null hypothesis at the .05 level. It may thus be concluded that the treatment did not have a significant impact on the enhancement of critical thinking abilities for the experimental group.

Discussion: The critical thinking appraisal evaluation (Form B) was used to determine whether the experimental group (after research treatment application) showed a greater proficiency in this area than the control group. As it was not the intention of this study to teach "critical thinking," it was deemed unnecessary to measure pretest results against those gathered in the posttest evaluation.

It should be pointed out that neither the Watson-Glaser, Cornell, or other appraisals specifically designed to measure

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the trait of "critical thinking" make any direct claims to effectively measure Bloom's higher order learning objectives. However, it is realistic to assume that at least in a de facto sense, they are addressing these traits, if only in an implicit manner, as they attempt to deal with the measurement of importantly related abilities such as inference, deduction, recognition, etc. These criteria require the utilization of higher order cognitive functions.

Although the posttest evaluation scores did indicate slightly higher performance for the experimental group, they were not significant. There could be many possible explanations for this result; however, this researcher believes that there were two principal reasons. First, the (Form B) appraisal was given after a previous series of test and over a relatively short period of time. Because of this fact both the control and experimental group were simply "tested out." There appeared to be little or no enthusiasm for taking one more examination. Several students had indicated that their primary concern was just to answer the questions and be done with the test. This being the case, one could easily conclude that there was lack of sufficient effort to evoke higher order functions. Put simply, many students appeared to have made an overt choice not to think about their answers.

The second, and equally important possibility, was the actual content of the critical thinking appraisal. There are many academicians who argue that it is impossible to adequately measure the comprehensive or circumspect judgments that are

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required by the concept of critical thinking; particularly through the use of multiple-choice questions. One of the most well respected and chief proponents of this belief is John McPeck. In his book, Critical Thinking and Education (1981), he critiques the Watson-Glaser test and suggests that it has serious deficiencies which vitiate its integrity as a test of critical thinking. He states: "First, within the test itself, there are numerous muddles and confusions that actually preclude the use of critical thinking in any defensible sense of the term. Second, the extensive database amassed by Watson and Glaser does little or nothing to show that critical thinking, as a unique or peculiar set of skills, is in fact being tested." After administering both (Form A) and (Form B) of the test, this researcher is inclined to agree with his assessment of its usefulness.

Survey Results

The data gathered on the post-experimental survey proved to be very helpful in assessing student reactions to the teaching methodology used in this research. (See Appendix: L, Table L-1) Some of the more interesting results were as follows:

1. Student responses to the question which asked if they felt that their learning of topic material covered in class had been helped through the use of System Dynamics indicated that 97% believed that the treatment had been beneficial.

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However, only 56% indicated that they would be interested in learning more about the technique.

2. The beginning of this treatment using the "new" learning approach caused 63% of the students to indicate that they experienced an increase in their level of apprehension about learning. Of this number, no one indicated a high level of increase, but 90% did express moderate apprehension.

3. Post-treatment apprehension measurement indicated that 15% of the students were now experiencing high levels of apprehension because of anxieties created during the learning process. The moderate apprehension levels had dropped to 44%.

4. System Dynamics was helpful in understanding the various concepts under study to 66% of the respondents, while 34% were either not sure or did not feel that it was beneficial.

5. On the subject of the desirability of having other courses being taught using the System Dynamics methodology, 19% of those surveyed believed that it would be a good idea and 58% were not sure. Twenty-three percent expressed a definite "no."

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6. Of those who did feel that other subjects could be taught more effectively by using this method, the most frequently suggested areas for incorporation were: economics, computers, and other management areas. (See Appendix: L, Table L-2)

7. The question relating to attention span during class showed that 41% indicated high levels of attentiveness, while 50% expressed moderate levels.

The last question on the survey requested students to list any comments about their in-class experiences which they might chose to make. A sample of those comments are listed below.

"Combining System Dynamics with reading and studying on your own was very helpful to me. It also opened up a new way of thinking."

"I found System Dynamics to be too slow, although it does come in handy at times I am easily bored with repetition."

"Brought to light an entirely new way of looking at and dealing with problems/situations. It's organized better and saves a lot of time and energy."

"I felt that it made you think, but that you had to discipline yourself to read the material in order to understand it."

A complete list of the survey comments may be found in Appendix: L, Supplement #2

Discussion: The survey results as a whole would seem to suggest that those students who participated in the experiment felt that it was, for the most part, beneficial to their

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learning the materials being studied. This feeling was corroborated by the statistical analysis performed on their test results data when compared to that of the control group students who did not receive the treatment.

This fact is of particular interest because experimental group students did not show an overwhelming interest in having the System Dynamics technique used in other courses which they might take. This raises an interesting question: If the System Dynamics technique was admittedly beneficial to their learning, why would they show a reluctance to seek future association with this methodology? It would be very difficult to assign a particular reason for this lack of interest; however, it is the feeling of this researcher that some of the possible causes are worth exploring.

Many individuals who are introduced to new ways of doing things are generally reluctant to abandon their present practices. They are in fact unwilling to leave the "comfort zone" which is associated with established and familiar procedures. A classic example of this behavior was found in the banking industry when the computer was first introduced as a tool to enhance employee production. The classroom in many ways, not unlike the work environment, in that students are often resistant and skeptical of change. This belief is substantiated by the fact that a majority of the students surveyed (22 out of 32) indicated that they experienced increased apprehension or anxiety levels. Many of their written comments alluded to the increased work load, as well

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as, the need to be more prepared for class. If these comments truly reflect their sentiments, then it is not difficult to understand the lack of willingness to seek future circumstances which would require them to work harder and become more involved in the learning process.

Another interesting point which was revealed by the survey showed that of those students who indicated an increase in apprehension and anxiety levels at the beginning of the System Dynamics treatment, none chose to identify it as being high; however, 60% did express moderate levels. This is noteworthy because 15% of the students indicated high apprehension levels at the conclusion of the treatment. It is the opinion of this researcher (based on classroom observations) that apprehension levels were very high for most of the classroom activities during the application of the teaching model. Indications of this included such things as: increased participation during class (especially student questions), more requests for instructor help after class, and a certain nervousness as expressed by student facial expressions.

It is also of note that although 97% of the students felt that System Dynamics was somewhat or very helpful, only 58% expressed a desire to learn more about the methodology. The remaining 42% were either not sure, or did not want to learn more.

The question relating to attention span also provided some valuable insights. Approximately 91% of the students surveyed stated that their attention span was moderate or high. Of

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those who fell into these two catagories, 59% indicated that this was different from their attentiveness in other classes, while 41% said it was the same. This being the case, these numbers would suggest that a substantial number of students were paying more attention in this class then they normally would in others.

Much of the data which was processed for the purpose of hypotheses testing did in fact reinforce the survey results as they pertain to the question of enhanced learning. The data gathered from the survey results did attest to the fact that students in the experimental group felt that they had experienced more learning because of the System Dynamics treatment model. This was also reflected in the statistical analyses of Hypothesis Number One, (Part 2), which measured students' abilities to identify the "next best" answer on those questions which they did not get correct answer at a .05 significance level. It was also reflected in Hypothesis Number Two which measured their adequacy of response to an essay question to be significant at the .01 level. It would appear that student perceptions of enhanced learning were indeed correct.

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CHAPTER V

SUMMARY, RECOMMENDATIONS AND CONCLUSIONS

Summary

The major focus of this study was to investigate the various effects which a specially designed teaching model (one which utilized System Dynamics techniques) would have on student learning. Particular emphasis was given to Bloom's three highest order cognitive learning functions (analysis, synthesis, and evaluation of data) which were designated to mean "critical thinking" for the purpose of this research. Attention was also given to Bloom's lowest order which is identified as knowledge, or the recall of specific and isolable bits of information.

This study utilized a teaching strategy, which was designed by the author and could be considered unconventional. Emphasis was given to the pursuit of dynamic thinking modes rather than traditional or linear modes. A quasi-experimental research design was selected as being most appropriate to effectively measure results. Two course sections of Human Resource Management were chosen and appropriately designated as a control or experimental group. Evaluation instruments used to gather data were either developed by this researcher or purchased from commercially available testing services. Examinations developed by this researcher were reviewed by colleagues for both content and adherence to acceptable design principles. A Likert-type scale was also developed and used in

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the scoring of the essay question to insure maximum reliability and consistency of grades. This is of particular note since essay question evaluation is recognized as being highly subjective in nature (see Chapter III).

Sixty-seven undergraduate Business Administration majors took part in the study and were not aware of their participation in a research project until all testing and evaluation had been completed.

Three hypotheses were tested (Hypothesis Number One consisted of two parts) to answer four major research questions based on four independent variables and four dependent variables (see Chapters III and IV). All of these three hypotheses, containing four research questions, were either supported or not supported as follows:

Hypothesis Number One (Part 1)

Hypothesis Number One (Part 1) was not supported. It was concluded that there was no significant positive correlation between the use of the teaching model and students' ability to improve testing results on an objective examination designed to measure lower order learning objectives. Students in the experimental group did achieve slightly higher scores than those in the control group; however, the difference was not sufficient to prove significant at the .05 level.

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Hypothesis Number One (Part 2)

Hypothesis Number One (Part 2) was supported. It was concluded that a significant positive correlation existed between the use of the teaching model and students' ability to select the "next best" correct answer (a positive detractor) when they were unable to chose the correct answer. Evaluation of test results indicated that students in the experimental group displayed a more consistent ability to find the second most appropriate answer. Test results, which included this consideration in the evaluation process, produced a score differential between groups that was significant at the .05 level.

Hypothesis Number Two

Hypothesis Number Two was supported. It was concluded that there was a significant positive correlation between the experimental group, which received the System Dynamics teaching model, and enhanced performance on the essay question designed to evoke the use of Bloom's higher order cognitive functions. It is this researchers belief that the systems approach to learning subject materials which incorporated Brunner's enactive, iconic, and representational modes (which are discussed in his theories on effective learning) contributed to their improved results as compared with the control group. The teaching model was structured to facilitate the process of "inquiry" or "discovery"

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training which he referred to in describing student participative roles in the educational experience. Both the in-class teaching activities, as well as the out-of-class homework exercises, were designed to focus students' attention on dynamic and systemic interpretations of subject materials. The essay question scores were significant at and beyond the .01 level.

Hypothesis Number Three

Hypothesis Number Three was not supported. It was concluded that there was no significant positive correlation between the use of the teaching model and students' ability to improve performance on the Watson-Glaser Critical Thinking Appraisal. This appraisal consisted of an eighty question objective test which was purchased from the Psychological Corporation and chosen by this researcher as being reasonably capable of measuring the higher order cognitive functions described by Bloom in his educational taxonomy. However, it should be noted that there is still a large amount of disagreement among scholars who have done much research in the area of critical thinking as to whether this construct is capable of being measured through the use of a testing format which relies entirely on objective variety questions.

Although members of the experimental group did achieve slightly higher test scores than the control

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group, there was not sufficient difference to reach significance at the .05 level.

Recommendations

1. Increased Emphasis By System Dynamicists On The Research And Publication Of Quantifiable Data To Substantiate The Benefits Of Qualitative System Dynamics Use

The results of this research project would seem to clearly suggest that there are many potential benefits to be gained through the incorporation and use of System Dynamics methodology as part of a strategy to improve student learning. It is also evident that these results are capable of being measured and evaluated against legitimate criteria. The literature review, which included articles written by Fey, Wolstenholm, Coyle, Destefano, et al. elucidated a desperate need to bring the System Dynamics technique more into the mainstream of educational application.

It is the opinion of this researcher that the time has come (an the facts warrant) for a more focused and conclusive approach in the identification and quantification of the benefits which this methodology could bring to more effective teaching. Results (heretofore identified by much of the research in this area as goal attainment, improved success ratios, etc.) must leave the realm of generalities and be premised on data which is capable of analysis and rigorous scrutiny.

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In turn, this approach will encourage the publishing and acceptance of research articles which for the most part have not found their way into mainstream educational periodicals such as The Journal of Educational Psychology, or Educational Leadership.

2. Wider Incorporation Of The System Dynamics Methodology As A Classroom Tool For The Facilitation Of Discovery Learning

The concept of "discovery" or "inquiry" learning was addressed in the first chapter of this research paper. In the introductory section, it was noted that leading educational theorist and practioners such as J. S. Brunner and Jean Piaget were advocates of this approach to learning because of its effectiveness in the area of engendering active student participation. The research data which was gathered from this experiment (particularly the post experimental survey) would seem to indicate that student participation was greatly increased for members of the experimental group. In turn, this group out-performed the control group in several of the areas that were measured for purposes of hypothesis testing.

More use of the System Dynamics technique in classroom environments would help to provide a data base which could prove invaluable in measuring its effectiveness, as well as, providing new and creative opportunities to expand its applications. This technique

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is entirely consistent with the presently accepted and popular systemic approaches to learning. In fact, it is really an extension or permutation of other highly visible methods (flow-charting, diagraming, decision-tree analysis, etc.) which are considered acceptable as tools to enhance learning.

The System Dynamics methodology has been used in this research in a manner which directly associates Bloom's higher order cognitive functions with a teaching model designed to improve student learning. One of the hypothesis under investigation suggested that student ability to answer essay questions would be enhanced. In fact, a very significant improvement was shown in the experimental group results as compared to the control group. It is the belief of this researcher that the use of System Dynamics as part of a teaching strategy might well be used to help accomplish such applauded educational objectives as writing across the curriculum. As mentioned above, results suggest that students demonstrate a better grasp of how to deal with essay questions when subject materials are taught using System Dynamics. They appear to have an improved ability to analyze, synthesize, and evaluate data and thus construct more thoughtful and effective essay responses.

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3. Evaluation Of Student Learning Styles To Investigate Possible Links With System Dynamics Effectiveness

It is well known that D. A. Kolb, in his 1976 publication of the Learning Styles Inventory Manual, outlined a Learning Styles Inventory (LSI) which was based on learning theory known as "experiential learning." It emphasized the cognitive perspectives of learning as a function of learner behavior. At the core of this experiential theory lies the notion that learning consists of four different stages. The four stages consist of: (a) concrete experience, (b) observation and reflection (c) formation of abstract concepts and (d) active experimentation. The individual learner actually involved in a learning situation theoretically goes through these four stages in sequential order.

It is the opinion of this researcher that future studies of the effectiveness of qualitative System Dynamics as a way to enhance learning should include a pre-evaluation of student learning styles using the Kolb index, or other appropriate instrument, to ascertain whether those individuals participating in the experiment could be classified as operating at a particular learning stage and as such be judged academically prepared or underprepared. This would permit evaluation results to be correlated with an identifiable level of preparedness. In turn, this information could be used to help determine

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where future uses of the methodology might be most effective.

4. More Emphasis On Concept Skill Models As Useful Generic Models

One area of possible System Dynamics application which has received little or no attention by system dynamicists is the development of generic models that could be used as educational tools, particularly as they relate to conceptual skill enhancement. This approach could be used as a means of reaching larger audiences and (hopefully) promoting greater acceptance of the qualitative, methodological, approach to which this research paper addresses itself.

Discipline areas such as management, organizational behavior, sociology, psychology, economics, etc. should be considered ready candidates for the development and introduction of generic models. These could be used to present learning materials in a format that would make concepts easier to understand and provide students with an opportunity to visually encounter the dynamic aspects of the discipline under study. Forester's Market Growth Model is a classic example of a quantitative generic model which used this approach for purposes of showing the flexibility of the System Dynamics paradigm as a tool for understanding complex systems. Why not apply this same strategy on a smaller scale by developing qualitative

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models which incorporate and demonstrate the variable relationships of important elements within other specific disciplines?

Graham and Scogin (1985) suggest that, "The purpose of a generic model, as the term is coming to be used, is not policy analysis per se, but education, including both formal and informal management education with organizations, as well as, school based education." If generic models can in fact be used to represent the underlying causes of commonly occurring sets of problems through the use of a basic framework (System Dynamics) which presents opportunities for clear and concise representation of subject materials, then more work needs to be done in order to make these models available for general use in our classrooms.

This approach would not only provide educators with a framework for "war stories," but could provide a means for students to remember and internalize both formal classroom instruction along with anecdotal information. Graham and Scogin (1985) further state that, "to a curriculum developer, a generic model offers an interesting nexus for tying together several educational technologies, including non-mechanical use of computers, video tapes, and extensive audience participation."

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Conclusions

It is suggested by this author that incorporation of the use of causal/influence diagraming techniques as a qualitative methodology may be considered an effective means of increasing student use of the higher order cognitive functions that are identified in Bloom's taxonomy of educational objectives. Careful design, construction, and implementation of the models to be used for application in this strategy for enhanced learning is of extreme importance if the intended results are to be maximized. The steps, which have been outlined in the teaching model, (See Appendix: A) provide an appropriate framework for this development. Some of the benefits to be gained from this approach are as follows:

1. enhanced student participation in classroom activities.
2. increased student ability to conceptualize content materials under study.
3. enhanced awareness and understanding of the variables being studied from a systemic perspective.
4. the development of student abilities to process information in a manner which facilitates retention of ideas and concepts.
5. a demonstrated ability of students to articulate ideas in a coherent manner.
6. improved written expression of ideas.

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APPENDICIES

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APPENDIX A

Teaching Model

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TEACHING MODEL

Introduction

In order to understand the rationale behind the construction and implementation of the teaching model, this section will provide both a substantive outline and explanation of the approach used to develop the System Dynamics applications as a treatment in this research. It describes how the System Dynamics technique, with its analysis of variable relationships in a causal/influence mode, was adapted for the purpose of developing an applicable treatment to explore the research hypotheses.

First, (Part I) will provide a detailed outline of the steps used to identify and format the content materials for use in classroom activities. This is presented as a detailed assessment of the developmental process as it relates to decisions in the construction and design of model content. The individual steps used in the model's construction were developed by this researcher. They are a composition of ideas and suggestions for model design that were encountered during the review of the literature on System Dynamics. A principal source of information was the book written by Roberts (1983) entitled, Computer Simulation: A System Dynamics Modeling Approach. This work dealt with the development of a method for understanding, representing, and solving problems through the incorporation of System Dynamics technique.

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Second, (Part II) provides a description of the classroom activities which took place during that period of time when the experiment was being conducted. These activities are detailed in a time-line and implementation chart which chronicles the sequence of events. It is felt by this researcher that the outline presented is sufficiently detailed to permit its use in the development of other course models where it has been determined that System Dynamics technique could be incorporated into classroom presentations.

Part I Developmental Activities (Considerations)

A. Evaluate Topic Materials

1. Relevancy of material content.
2. Adaptability of materials to dynamic systems loops.
3. Knowledgeability of instructor in subject area under consideration.

o The question of relevancy as it relates to the selection of topic materials for use in a particular applications treatment is always a highly subjective activity. However, having taught a variety of management subjects over the past fifteen years it was this researcher's opinion that Human Resource Management would be an appropriate topic for use with System Dynamics technique. The modular nature of the topic materials covered in this field, with its

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natural development into identifiable subsystems, made it particularly adaptable for experimental treatment of a model designed to utilize the concept of System Dynamics in teaching.

B. Selection Of Materials To Be Covered

1. Identify general ability level of student population.
2. Incorporate subject material into lesson plan in a logical manner.
3. Consider the time available for application.
4. Identify logical units of material presentation.
   a. How might material be incorporated into present plan?
   b. Could material be treated as ancillary to present lesson plans?
   c. Should material be treated as a separate topic?

o A general analysis was conducted of the student population presently enrolled at New Hampshire College. This was accomplished through the use of ISIS (Integrated Student Information System) which is a computerized record of all students in attendance at the college. The academic profile which this researcher received indicated that as a group NHC students had been average, or slightly above, while

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attending high school, and for the most part scored below national norms on their SAT scores. (The average score for New Hampshire College students was 880.) It also indicated that their Grade Point Average (GPA) was in the C+ range. It would not be unfair to generally classify NHC students as underprepared in high school and average performers in college. These assumptions were important in preparing treatment materials.

The textbook selected for this course was "Personnel Management and Human Resources" by William B. Werther Jr. and Keith Davis (1985). It is not a particularly difficult book and presents topic materials as modular units which enhanced its compatibility with System Dynamics applications designed specifically for use in this experiment. Chapter Four (Human Resource Planning), Five (Job Analysis and Design) and Six (Recruitment of Human Resources) were chosen by this researcher as being compatible with the System Dynamics analysis technique used in this model. These chapters were also chosen because their content closely paralleled the materials covered in the Personnel Accreditation Institute (PAI) guidelines of relevant subject areas within the field of Human Resource Management.

It was this researcher's decision that the model's use could most easily be facilitated by

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incorporating it into the present lesson plan as outlined by the course syllabi. (See Appendix: B) Identical materials would be covered by both class sections studying Human Resources/Personnel Management, but one group would be used for control purposes and the other for experimental purposes. Chapters were not rearranged and care was given to assure that each learning group would have identical, in-class, time exposure to the materials being covered. Four (4) weeks were allocated to cover this module.

C. Identify Variables To Be Used In System Dynamics Model

1. Identify which variables best explain the particular system under study.
2. Use variables in a manner capable of demonstrating causal/influence relationships in an action mode.

o Variables for incorporation into the teaching model were selected with an awareness for their need to demonstrate the appropriate interaction of causality/influence within the Human Resource system used for this study. Special attention was given to the selection of "key words" which represented elements in the system and could best demonstrate the

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concepts presented for learning. This was done to assist student understanding of how variables relate to each other in a dynamic manner through feedback activity. Both personal experience and the use of "key word" sections at the end of each chapter were brought to bear on the selection of variables to be used. Although it is understood that the process of selection and placement of variables is subjective to the instructor's assessment of what is important, one should attempt to minimize the number of variables included in a given example or practice exercise. For this reason, I have chosen twenty to thirty variables per system as being consistent with this goal.

D. Develop Examples Of Behavioral Reference Graphs (BRG) And System Dynamic Loops For Classroom Explanation Of Concepts

1. Use examples simple enough to be understood.
2. Consider whether variables used show how cause/influence relationship works.
3. Use examples that demonstrate both positive (+) and negative (-), relationship of variables.
4. Identify the loop signs associated with the variables used in a particular loop.
5. Show relationship of exogenous and endogenous variables to loop structure.

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6. Establish closure of all loops within the system.

o For the purpose of introducing the students in the experimental group to the concept of System Dynamics, several examples were constructed to illustrate the concept of interactive feedback within a system. These were designed to be simple and understandable. (See Appendix: C, Fig. #1) Emphasis was given to an explanation of how System Dynamics works through the use of reinforcing and correcting influences among variables. Reference behaviors graphs were also used for the purpose of illustrating problem identification and deviation from some acceptable or predetermined norm.

E. Develop Practice Sets For In-class And Homework Assignments

1. Construction of a clear set of instructions for explanation of homework exercises.
2. Use examples that deal with the concepts students are studying.
3. Determine that practice sets are understandable and complete.
   a. Are the variables in each exercise limited to a reasonable number?
   b. Are the variables incorporated correctly?

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- In order to accomplish an effective integration of the System Dynamics concept into a practical experience for students, a series of practice exercise sets were developed to match the content areas (topic chapters) which were designated as appropriate for use in this research project. (See Appendix: D, Exercise #1 through #5) Each set consisted of an instruction sheet containing the variable to be used in the exercise along with a predrawn loop which represented the chapter materials depicted in a systems format. In some cases, the exercise contained two parts or sets of variables and loops in order to enhance student manageability for purposes of learning. All of the variables used in the exercises were "scrambled" and required the students to identify where they should be located in the predrawn loops. Given the limited class time available to conduct this research, it was decided that it would be demanding too much to expect students to draw their own loops. For this reason, predrawn loops were included with each set of exercises.

  The main focus of this activity was to enhance students' ability to deal with the analysis, synthesis, and evaluation of information as it related to causal/influence modes of application.

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They were required to place variables in correct relationship to other variables and to identify the appropriate positive (+) or negative (-) sign identification.

An asterisk was used to indicate where a particular variable was common to more than one exercise. After all practice sets had been discussed in class, each student was given a completed copy of all exercise sets. (See Appendix: C, Figures 2 through 4)

F. Develop or Identify Instruments To Measure Performance Results Differences.*

G. Application Of Instrumentation*

H. Analysis And Evaluation Of Results*

---

* For an indepth consideration of items F through H, reference should be made to Chapters 3 and 4.

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Part II Implementation

Because this research project was designed to measure the effects of the teaching model on learning enhancement, it was this researcher's belief that an appropriate experiment would require that both a control and experimental group be established. These groups and the activity sequences relevant to actual in-class teaching technique are identified in a time-line, implementation chart as E1 (receiving System Dynamics treatment method), and C (not receiving treatment). All chapter content materials were assigned for reading prior to class through the use of an appropriately constructed syllabus. (See Appendix: B, Part II)

A. Control Group (C)

The control group population was taught all materials in chapters 4, 5, and 6 using the standard lecture procedures normally associated with traditional pedagogy. This included: 1) complete lecture on chapter content; 2) class discussion of materials presented; 3) use of transparencies to provide examples for clarification; 4) selected homework assignments, etc. (See Appendix: E, Implementation Chart - control group)

B. Experimental Group E1

The experimental group population received the treatment of being taught course material through the

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use and integration of System Dynamics modeling techniques as applied to Chapters 4, 5, and 6. They did not receive the traditional pedagogical approach that was experienced by the control group. Emphasis was placed on the exploration of chapter materials as they manifested themselves in dynamic system relationships. This included: 1) differences between linear and dynamic thinking 2) identification of problems through the use of behavioral reference graphs; 3) appropriate selection and placement of system variables; 4) differences in reinforcing and correcting influences of variables as they exert positive or negative impact within loops structures; and 5) loop closure concepts. (See Appendix: E, Implementation Chart - experimental group)

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APPENDIX B

Personnal/Human Resource Syllabus

1. Part I: Course Objectives
2. Part II: Course Outline

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SYLLABUS (PART I)
ADB 211 Human Resource/Personnel Management — Fall 1987
Prof. John K. Evans

Course Objective:

The principle focus of activity in this course will be the study of effective and efficient ways to manage human resources. It has become increasingly apparent to the leaders of business and industry over the last two decades that successful management techniques must certainly include a larger component of people oriented planning. This awareness has emerged through a careful analysis of the factors of production (i.e. land, labor, capital, technology, and entrepreneurial ability), and how these various elements must be combined in an ever more precise manner in order to achieve corporate goals and objectives.

Today's business environment is constantly growing in both complexity and competition. The continued incursion of foreign made products into the American market place has heightened a sense of awareness and urgency on the part of businessmen throughout the country. They have been prompted to look more closely at their input resource mix and to focus on the identification of those areas which have been under-utilized in the past. One of the emerging themes to come out of these investigations has been the recognition that people (labor) as a factor of production have been the most neglected resource from the perspective of potential. In the truest sense, all but one of the factor inputs have some limited or finite qualities about them; however, this fact does not apply to human potential and the inherent opportunities for application of management techniques to unlock this untapped bounty.

Over the past two decades, the science of management has begun to dramatically change its thinking as applied to the human resource factor; emphasis has begun to shift toward a more integrated and enlightened approach. (Perhaps the Japanese have forced this action with their Theory Z techniques!) The people factor has been elevated to a status of equal importance with all of the other input resources. We shall look at this fact closely in our studies of effective human resource management and how it impacts on the successful attainment of b usiness goals and objectives. "How are we going to do this?" I THOUGHT THAT YOU WOULD NEVER ASK.

In order to fully prepare you - the students at NHC - for the rigors of the real work world, we are going to approach this course from the perspective of "competency" ahievement. There are certain levels of proficiency or skills (competencies) that an effective manager must have in order to interact with, and manage, the human resources for which he or she will be given responsibility. To facilitate the acquisition of these skills, I have developed a list of four competency areas that it is essential for you to understand and know how to apply. These are outlined in the course content section of this syllabus and also contain an outline of subset achievement strands which will assist you in identifying the important building blocks from which they are derived.

"You will be held responsible for the attainment of acceptable levels of understanding in each of the defined competency areas. It is my fondest wish and desire that you try very hard to reach this goal. It is also my personal belief that if you do, you will become more effective leaders and successful managers."

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Student Learning Goals: It is reasonable to expect the college student to STUDY and to LEARN. This is an important part of what your stay here at NHC is all about. It is an opportunity for you to benefit from the knowledge and experience that has been acquired by those who have expertise in specific disciplines that directly relate to your chosen field of study. In this particular course, you should be striving to attain knowledge which will help you to become competent in the art and science of GOOD people management.

- Try to develop the ability to analyze and synthesize information presented in this course as it relates to the concepts of Human Resource Management. There is a "synergistic" effect (look up the word) that always takes place in a successfully managed personnel system.
- Understanding situations by evaluating the "dynamics" which takes place between the interacting component parts as viewed from both a human and corporate needs perspective.
- Attempt to develop your interpersonal skills thorugh class participation and discussion of why you do, do not agree with a particular point of view expressed by the teacher or fellow student.
- Sharpen your communication skills, the most essential tool for working effectively with others.

Course Requirements:

1. Attend class on a regular basis. Continuity is an extremely important factor in the learning process.
2. Come to class prepared to participate in a learning experience. As a minimum, you should have all homework assignments completed and up to date. You will be held responsible for the content of any classroom handouts, movies or any other audio/visual materials which are used to present ideas in class. Any of the topics that may be addressed through the use of these resources is to be considered fair game for inclusion on examinations. You are NOT responsible for materials covered in the text but not in class unless specifically noted by the instructor.
3. Take part in class discussions and get involved in the subject matter to the fullest extent possible.
4. Students must complete all course requirements, tests, term projects, oral presentations, etc. before a grade will be issued.

Examinations:

1st Exam 30%
(This test will contain true or false questions and one multi-part essay.

Final Exam 30%
(This test will be of the essay variety and will directly relate to the competencies that were addressed earlier in this syllabus. You will have a choice of questions to answer and it is expected that you will be able to draw upon knowledge acquired during the entire semester to construct the appropriate answers.)

Projects 30%
The term project for this semester (re: attachment) will be completed on time and use the suggested formatting guidelines. We shall discuss these projects at further length during the first two weeks of class.

Participation 10%
Whether you like it or not, life requires that you participate! This class will be a good place for you to get used to it.

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Course Content: The content material in this course has been selected, designed and developed to enhance your knowledge and application of those skills which will be required to implement effective Human Resource Management. The four primary strands of study and their subsets are listed below.

A. Human Resource Challenges of the 80's - (The latter part of the 20th century has ushered in an era of increased social consciousness. With this awareness, the federal government has perceived the need for its increasing presence in the monitoring of business activity as it relates to policies of social justice in the work environment. Because of this fact, government agencies have enacted many pieces of legislation designed to be proactive in this regard.)

B. Human Resource Planning - (In order to effectively organize and manage any activity, one must be able to gather and analyze relevant facts for the purpose of successful decision-making; this is no less true for people management. "If we do not know where we are going, how will we know if we have arrived?")
   1. Forecasting Techniques For Resource Planning
   2. Job-Analysis and Job Design
   3. Recruitment and Selection of Employees
   4. Automated Human Resource Systems

C. Human Resource Development and Evaluation - (It should come as no surprise to anyone that we are presently involved in the greatest technological revolution in the history of mankind. Products and their production processes are becoming increasingly more complicated as are the job-tasks which surround their activity. The result is to place greater stress on the employee to become more adaptive and flexible if he/she is going to be an effective worker. In addition, upward mobility as it relates to opportunities for more income and job advancement, with their attendant satisfactions, can only be accomplished when one is equipped to assume new challenges. Because of this, such areas as training, carreer planning, performance appraisal, etc. play a major role in successful human resource management. A system which adequately addresses these concerns will be acting in a manner which greatly facilitates employer/employee relationships.
   1. Job Orientation and Placement Activities
   2. Training and Development Programs
   3. Career Pathing/Planning For Employee Needs
   4. Performance Appraisal and Compensation Analysis
   5. Benefit Programs and Employee Safety

D. Union Management Relations - (Approximately 17% of the total workforce in the US is unionized. The figure has decreased slightly from a high of 25% in the past World War II era; however, it still constitutes a significant portion of the workforce, and one which you (the student) may have to deal with when you enter the field of management. It is vitally important to understand what a union is; why it exists; what its primary objectives are; and how you can most effectively accomplish organizational goals in a union environment.)
   1. Union/Management Relationships
   2. Collective Bargaining and Contract Administration

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Mr. John Evans | SYLLABUS (PART II) | Fall 1987

ADB 211 HUMAN RESOURCE/PERSONNEL MANAGEMENT

Required text: Werther and Davis, Personnel Management and Human Resources, 2nd Ed., McGraw-Hill series.

Course Outline:

Week Ending	Topics	Assignments
9/12/87	The Challenge of Personnel Management (Discuss Term Projects)	C. 1
9/19/87	Environmental Challenges Equal Employment Opportunity	2 3
9/26/87	Chapters 4, 5, and 6 Introduction to Systems Dynamics as a Tool for Enhanced Understanding of How Systems Work - Lecture	4
10/3/87	Human Resource Planning Handout: Job Design - Overview Homework assignment - given in class	5
10/10/87	Recruitment of Human Resources Handout: Job Design - Job Redesign Homework assignment - given in class	6
10/17/87	Employee Selection Review Term Project Status	7
10/24/87	First Exam --- Chapters 4, 5, & 6 Orientation and Placement Article: An Introduction to Computer Based Learning T&D 5/83	8
10/31/87	Training and Development Career Planning	9 10
11/7/87	Performance Appraisal Compensation Management	11 12
11/14/87	Employee Benefits and Services	13
11/21/87	Lecture AHRIS - Automated Human Resource Information Systems Final Status Report on Term Projects	
11/28/87	The Union-Management Framework Bargaining and Contract Administration	20 21
12/5/87	Catch-Up Session Term Projects - All project reports are to be presented in class - NO EXCEPTIONS!	
12/12/87	Final Project Reports	

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APPENDIX C

System Dynamics Reference Diagrams

1. Concept Overview (Figure C-1)
2. Chapter 4 (Figure C-2)
3. Chapter 5 (Figure C-3)
4. Chapter 6 (Figure C-4)

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FIGURE C-1

Concept Overview

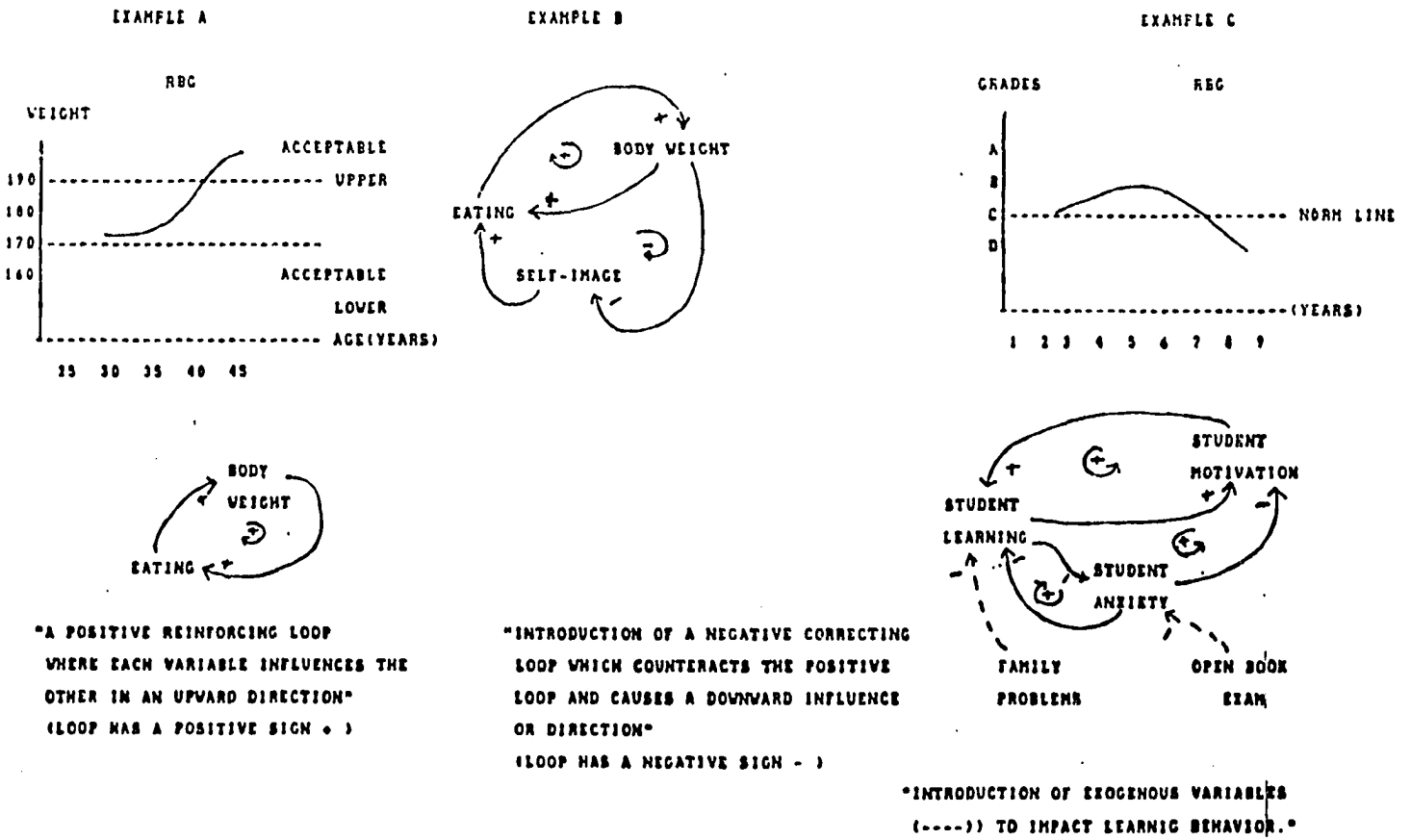

FIGURE C-2

Chapter 4 - Human Resource Planning

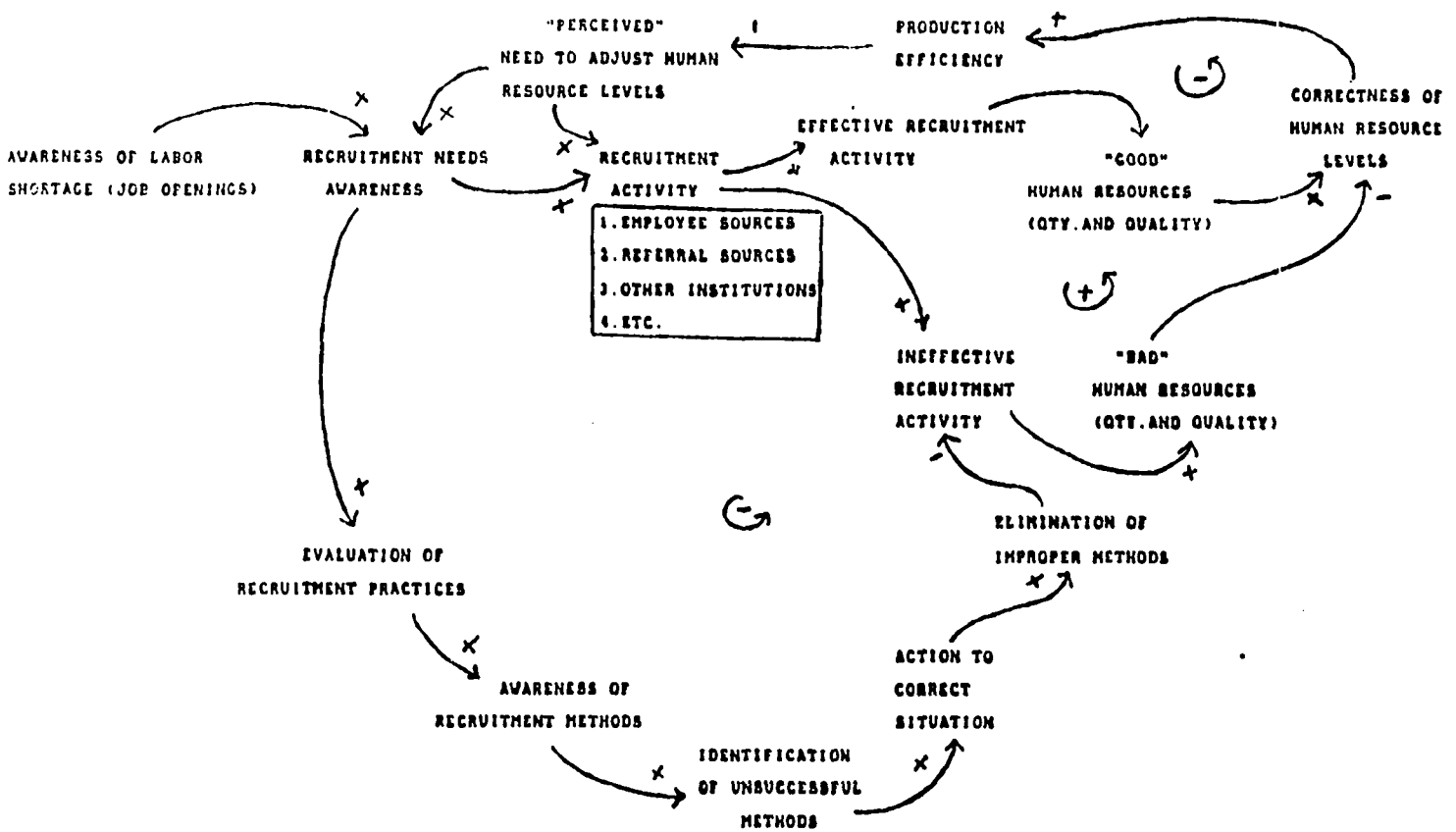

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FIGURE C-3

Chapter 5 - Job Analysis and Design

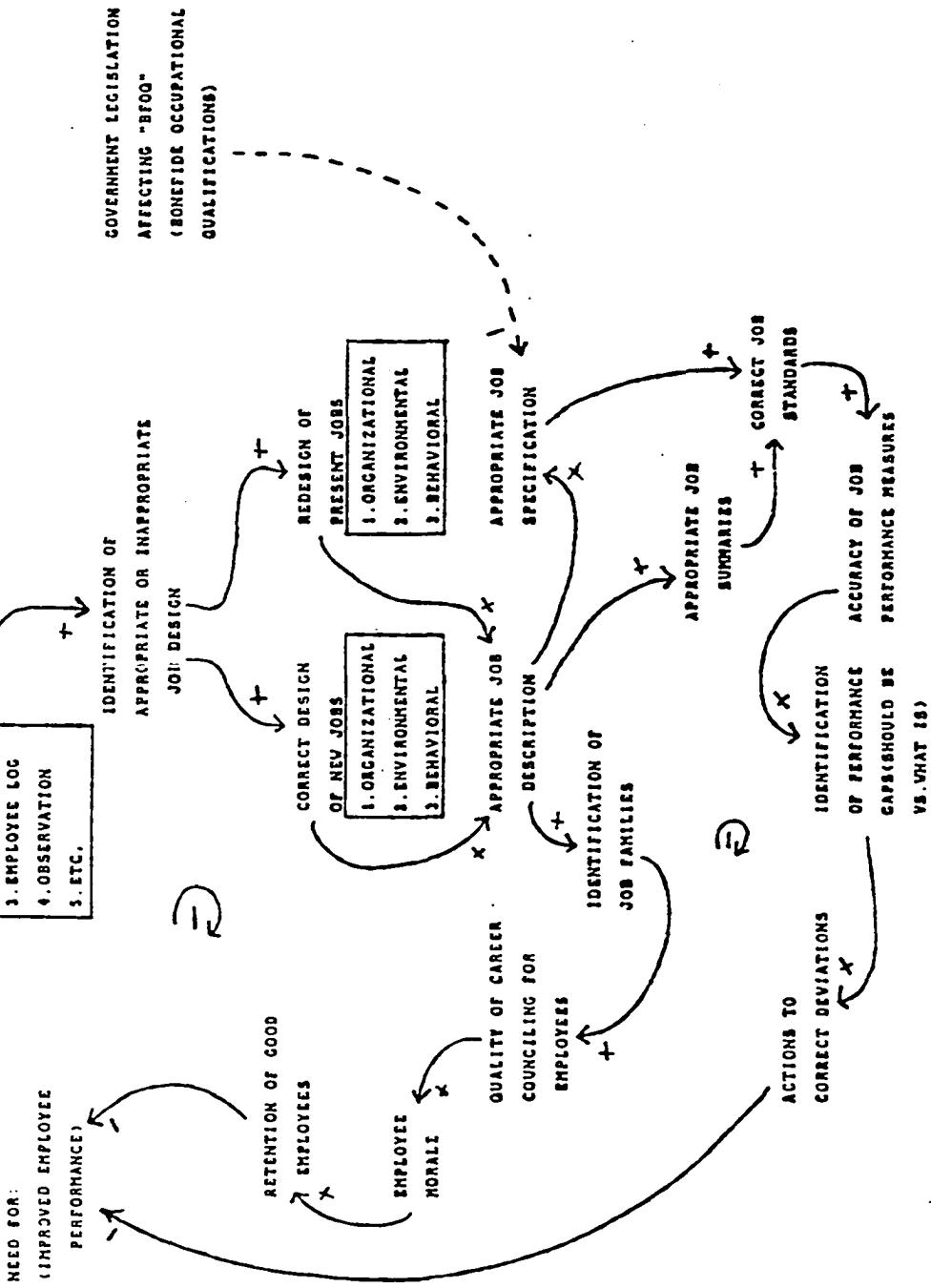

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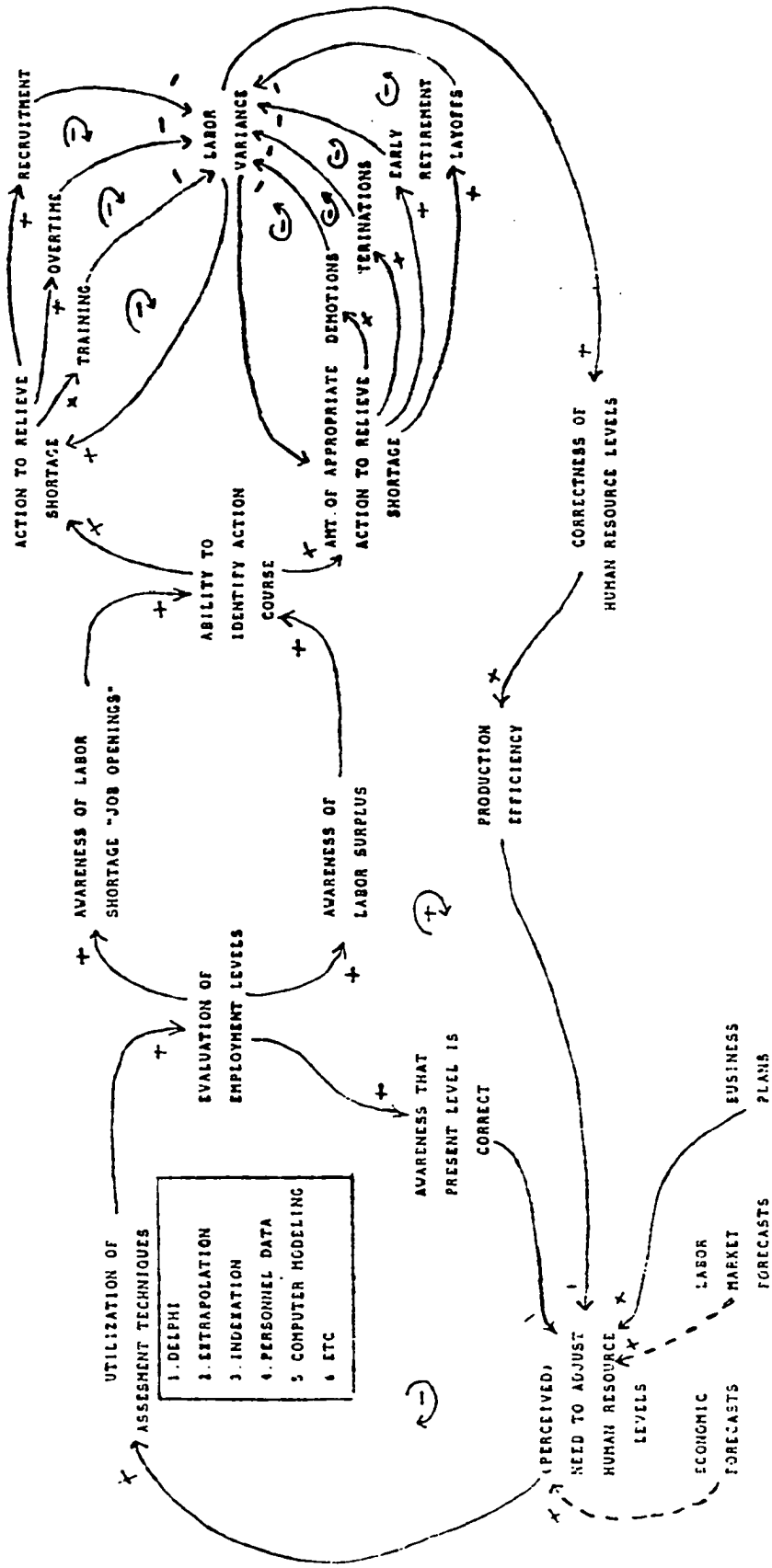
FIGURE C-4

Chapter 6 - Recruitment of Human Resources



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APPENXIX D

Homework Assignment Practice Sets

1. Exercise #1
2. Exercise #2
3. Exercise #3
4. Exercise #4
5. Exercise #5

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Exercise #1 (C4PIE1)
Practice Sets

Instructions:

Please read the following carefully!

1. Use the variables listed below to complete the Systems Dynamics exercise. Location of the brackets ( ) indicates where variables are to be placed within the system. There is no, I repeat no, relationship between the size of brackets and the length of variable descriptors to be used at any given location.

2. Indicate the causal/influence relationship between variables with the correct positive (+) or negative (-) sign.

3. Assign a positive or negative value to each loop in the system. (e.g. ⊕ or ⊖)

   * Remember, an odd number of negative signs 1, 3, etc. means a negative or correcting loop. When we have an even number of negative signs 0, 2, 4, etc., the loop is a positive or reinforcing loop.

Variables to Be Used:

These variables have been placed in a scrambled order; it is up to you to determine their relationship to each other within the system diagram for this exercise.

Chapter 4 - Part I
Exercise 1

1. Business Plans
2. Awareness that present level is correct
3. Labor market forecasts
4. Utilization of assessment techniques
5. Need to adjust human resource levels
6. Evaluation of employment levels
7. Ability to identify action course *
8. Economic forecasts
9. Awareness of labor shortage (job openings)
10. Awareness of labor surplus

* This variable is common to both exercise #1 and exercise #2.

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Chapter 4 - Part I
Exercise # 1
(C4PIE1)

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Exercise #2 (C4PIIE1)
Practice Sets

Instructions:

Please read the following carefully!

1. Use the variables listed below to complete the Systems Dynamics exercise. Location of the brackets ( ) indicates where variables are to be placed within the system. There is no, I repeat no, relationship between the size of brackets and the length of variable descriptors to be used at any given location.

2. Indicate the causal/influence relationship between variables with the correct positive (+) or negative (-) sign.

3. Assign a positive or negative value to each loop in the system. (e.g.  or)

   * Remember, an odd number of negative signs 1, 3, etc. means a negative or correcting loop. When we have an even number of negative signs 0, 2, 4, etc., the loop is a positive or reinforcing loop.

Variables to Be Used:

These variables have been placed in a scrambled order; it is up to you to determine their relationship to each other within the system diagram for this exercise.

Chapter 4 - Part II
Exercise 2

1. Labor variance
2. Ability to identify action course *
3. Amount of appropriate action to relieve surplus
4. Recruitment
5. Demotions
6. Amount of appropriate action to relieve shortage
7. Layoffs
8. Overtime
9. Terminations
10. Early retirement
11. Training

* This variable is common to both exercise #1 and exercise #2.

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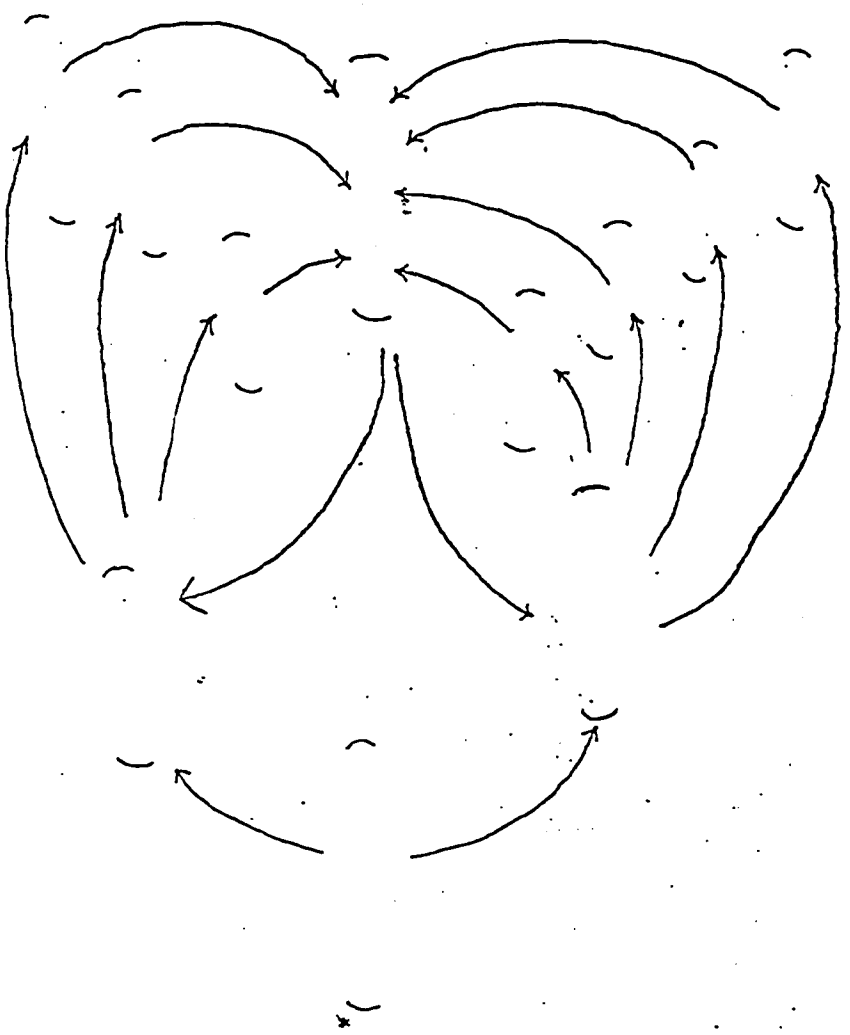
Chapter 4 - Part II
Exercise # 2
(C4PIIE2)



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Exercise #3 (C5PIE3)

Practice Sets

Instructions:

Please read the following carefully!

1. Use the variables listed below to complete the Systems Dynamics exercise. Location of the brackets ( ) indicates where variables are to be placed within the system. There is no, I repeat no, relationship between the size of brackets and the length of variable descriptors to be used at any given location.

2. Indicate the causal/influence relationship between variables with the correct positive (+) or negative (-) sign.

3. Assign a positive or negative value to each loop in the system. (e.g.  or )

   * Remember, an odd number of negative signs 1, 3, etc. means a negative or correcting loop. When we have an even number of negative signs 0, 2, 4, etc., the loop is a positive or reinforcing loop.

Variables to Be Used:

These variables have been placed in a scrambled order; it is up to you to determine their relationship to each other within the system diagram for this exercise.

Chapter 5 - Part I
Exercise 3

1. NEED FOR: inproved employee performance *
2. Data collection
3. Retention of good employees
4. Job analysis
5. Correct design of new jobs
6. Appropriate job descriptions
7. Employee morale
8. Identification of job families
9. Quality of career counceling for employees
10. Identification of appropriate or inappropriate job design *

* These variables are common to both exercise #3 and exercise #4.

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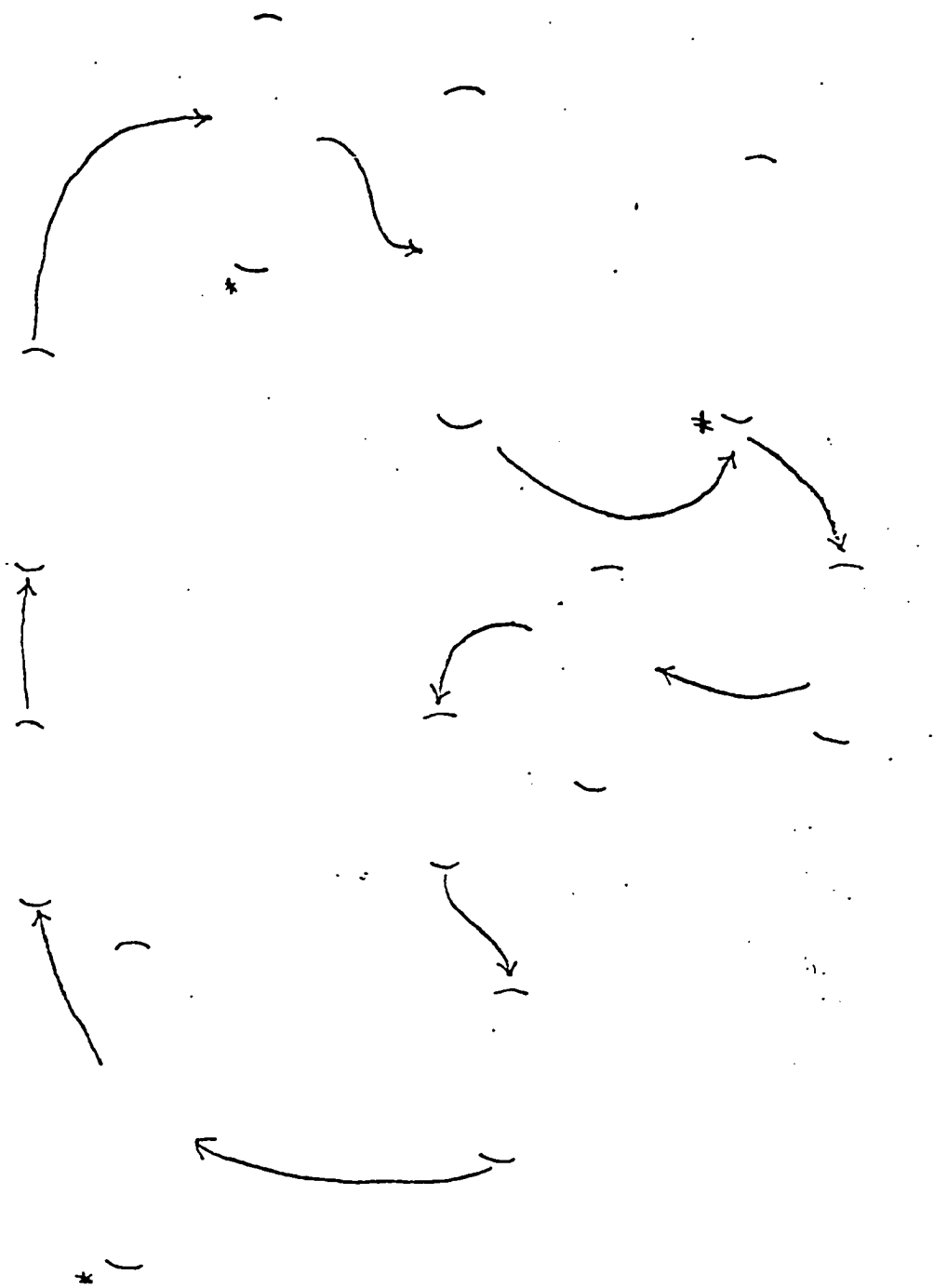
Chapter 5 - Part I
Exercise # 3
(C5PIE3)



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Exercise #4 (C5PIIE4)

Practice Sets

Instructions:

Please read the following carefully!

1. Use the variables listed below to complete the Systems Dynamics exercise. Location of the brackets ( ) indicates where variables are to be placed within the system. There is no, I repeat no, relationship between the size of brackets and the length of variable descriptors to be used at any given location.

2. Indicate the causal/influence relationship between variables with the correct positive (+) or negative (-) sign.

3. Assign a positive or negative value to each loop in the system. (e.g.  or)

   * Remember, an odd number of negative signs 1, 3, etc. means a negative or correcting loop. When we have an even number of negative signs 0, 2, 4, etc., the loop is a positive or reinforcing loop.

Variables to Be Used:

These variables have been placed in a scrambled order; it is up to you to determine their relationship to each other within the system diagram for this exercise.

Chapter 5 - Part II
Exercise 4

1. Identification of appropriate or inappropriate job design *
2. Government legislation affecting BFOQ (Bona Fide Occupational Qualifications)
3. Appropriate job descriptions *
4. Redesign of present jobs
5. Accuracy of job performance measures
6. Action to correct deviations
7. Identification of performance gaps
8. Appropriate job specifications
9. NEED FOR: improved employee performance *
10. Appropriate job summaries
11. Correct job standards

* These variables are common to both exercese #3 and exercise #4.

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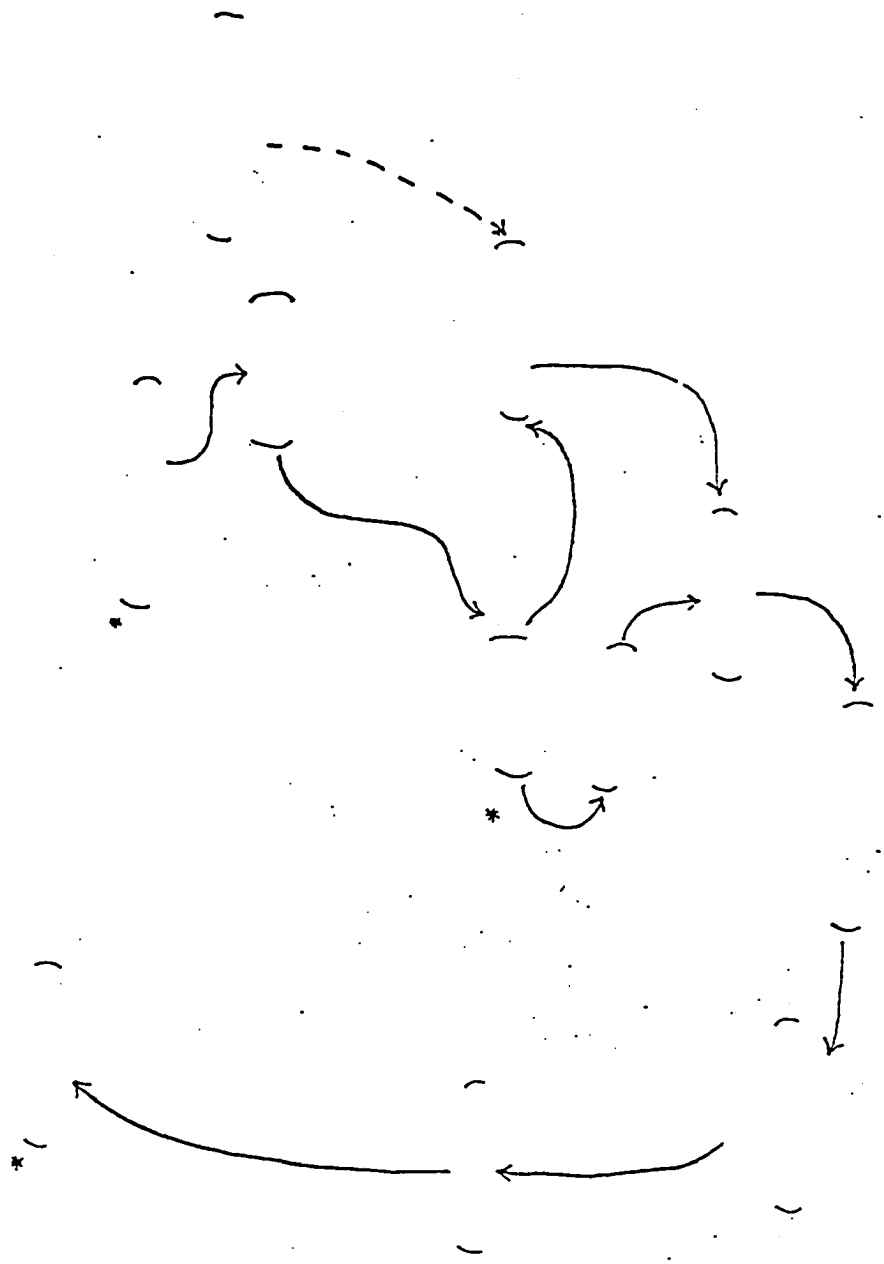
Chapter 5 - Part II
Exercise # 4
(C5PIIE4)



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Exercise #5 (C6E5)

Practice Sets

Instructions:

Please read the following carefully!

1. Use the variables listed below to complete the Systems Dynamics exercise. Location of the brackets ( ) indicates where variables are to be placed within the system. There is no, I repeat no, relationship between the size of brackets and the length of variable descriptors to be used at any given location.

2. Indicate the causal/influence relationship between variables with the correct positive (+) or negative (-) sign.

3. Assign a positive or negative value to each loop in the system. (e.g. ⊕ or ⊖)

   * Remember, an odd number of negative signs 1, 3, etc. means a negative or correcting loop. When we have an even number of negative signs 0, 2, 4, etc., the loop is a positive or reinforcing loop.

Variables to Be Used:

These variables have been placed in a scrambled order; it is up to you to determine their relationship to each other within the system diagram for this exercise.

Chapter 6
Exercise 5

1. Awareness of labor shortage (job openings) *
2. Recruitment activity
3. Correctness of human resource levels
4. Recruitment needs awareness
5. Elimination of improper methods
6. Bad human resources (Quality and Quantity)
7. Ineffective recruitment activity
8. Action to correct situation
9. Identification of unsuccessful methods
10. Evaluation of recruitment practices
11. Effective recruitment activity
12. Good human resources (Quality and Quantity)
13. Production efficiency
14. "Perceived" need to adjust human resource levels
15. Awareness of recruitment methods

* These variables are common to both exercise #1 and exercise #2.

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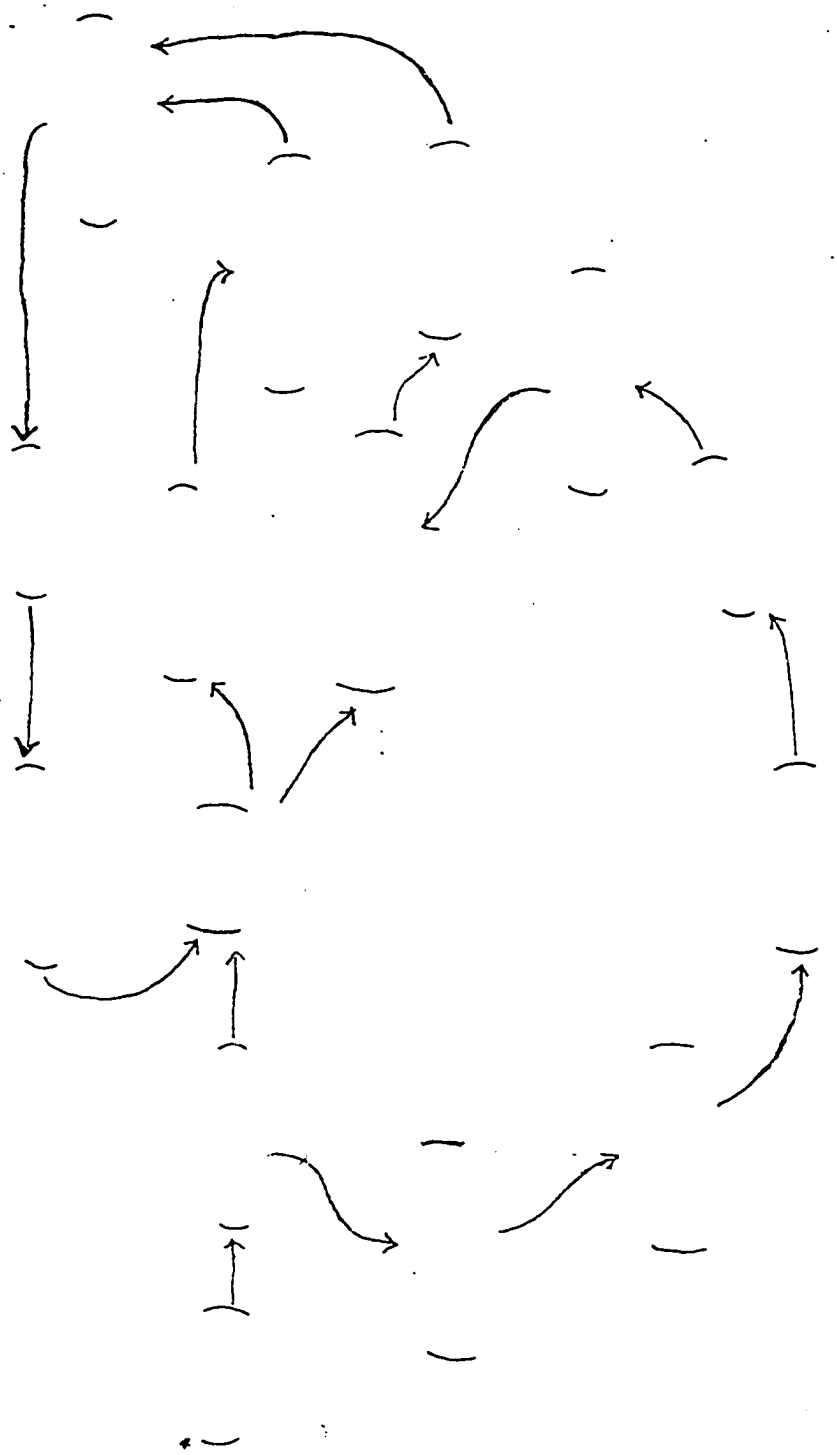
Chapter 6
Exercixe #5
(C6E5)



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APPENDIX E

Implementation Charts

1. Control Group C
2. Experimental Group E1

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IMPLEMENTATION CHART C
(Control Group C)

CLASS SESSION	NO.	ACTIVITY	APPROXIMATE TIME	MATERIAL	EQUIPMENT
1	1	Lecture on Chapter Four: Human Resourse Planning To include complete coverage of all content materials and the use of transparencies for clarification and example	50 minutes	transparencies 4-1 thru 4-12	overhead projector, blackboard
	2	Discussion of concepts that students wish to explore further	20 minutes		
	3	Explanation of homework assignment	5 minutes		
	4	Supplement Handout	5 minutes		
2	1	Review of homework assignment	40 minutes	transparencies	overhead projector
	2	Supplemental materials - Human Resourse Planning: A Roadmap For Success	30 minutes	Handout Understanding Human Resourse Planning	
	3	Brief overview of next chapter	10 minutes		
3	1	Lecture on Chapter Five: Job Analysis and Design To include complete coverage of all content material and the use of transparencies for clarification and example	50 minutes	transparencies 5-1 thru 5-11	overhead projector, blackboard
	2	Discussion of concepts that shudents with to explore further	20 minutes		
	3	Explanation of homework assignment	5 minutes		
	4	Supplement Handout	5 minutes		

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IMPLEMENTATION CHART C
(Control Group C)

CLASS SESSION	NO.	ACTIVITY	APPROXIMATE TIME	MATERIAL	EQUIPMENT
4	1	Review of homework assignment	40 minutes		
	2	Supplemental materials: Understanding Job Design	30 minutes	transparencies	overhead projector
	3	Brief overview of next chapter	10 minutes		
5	1	Lecture on Chapter Six: Recruitment of Human Resources	50 minutes	transparencies 6-1 thru 6-7	overhead projector, blackboard
	2	Discussion of concepts that students wish to explore further	20 minutes		
	3	Explanation of homework assignment	10 minutes		
6	1	Review of homework assignment	40 minutes		
	2	Discussion of identified relationships and synergism of Chapters 4, 5, and 6	30 minutes		blackboard
	3	Brief overview of next chapter	10 minutes		

IMPLEMENTATION CHART E1
(Experimental Group E1)

CLASS SESSION	NO.	ACTIVITY	APPROXIMATE TIME	MATERIAL	EQUIPMENT
1	1	Introductory explaination and lecture on the Systems Dynamics concept and how this methodology will be used in class. To include: A. Difference between lineal and dynamic thinking B. Concept of a system and its variables C. Identification of deviant behavior (reference behavior graphs) D. Explaination of exogenous and endogenous variables E. Identification of variable causal/influence signs F. Inpact relationship of variables in association 1. Positive (reinforcing) effect 2. Negative (correcting) effect G. Effect of Exogenous variables on systems H. System closure	40 minutes	Handout Figure #1	Blackboard
	2	Discussion of concepts for clarification	30 minutes		

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IMPLEMENTATION CHART E1
(Experimental Group E1)

CLASS SESSION	NO.	ACTIVITY	APPROXIMATE TIME	MATERIAL	EQUIPMENT
2	1	Brief overview lecture on Chapter Four: Human Resourse Planning	15 minutes	transparencies (as required)	blackboard, overhead projector
	2	Identification of variables to be used in constructing a systems model for this chapter.	10 minutes		
	3	Reclarification of Systems Dynamics concepts not understood by students	10 minutes		
	4	In-class assignment of Practice Set Exercise #1	20 minutes	handout exercise #1	
	5	In-class review of Exercise #1	20 minutes		
	6	Explanation of homework assignment Exercise #2	5 minutes	handout exercise #2	
3	1	Review of homework assignment #2	20 minutes		
	2	Identification of both assignments as a complete system to explain dynamic relationships of Chapter Four content variables.	30 minutes	handout figure #2	
	3	Discussion of problems relating to students' understanding of system	20 minutes		
	4	Brief overview of next chapter	10 minutes		

IMPLEMENTATION CHART E1
(Experimental Group E1)

CLASS SESSION	NO.	ACTIVITY	APPROXIMATE TIME	MATERIAL	EQUIPMENT
4	1	Brief lecture on Chapter Five: Job Analysis adn Design	20 minutes	transparencies (as required)	blackboard, overhead projector
	2	Identification of variables to be used in constructing a systems model for this chapter.	10 minutes		
	3	In-class assignment of Practice Set Exercise #3	25 minutes	handout exercise #3	
	4	In-class review of Exercise #3	20 minutes		
	5	Explanation of homework assignment Exercise #4	5 minutes	handout exercise #4	
5	1	Review of homework assignment #4	20 minutes		
	2	Identification of both assignments as a complete system to explain dynamic relationships of Chapter Five content variables.	30 minutes	handout Figure #3	
	3	Discussion of problems relating to students' understanding of systems.	20 minutes		
	4	Brief overview of next chapter	10 minutes		

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IMPLEMENTATION CHART E1
(Experimental Group E1)

CLASS SESSION	NO.	ACTIVITY	APPROXIMATE TIME	MATERIAL	EQUIPMENT
6	1	Brief lecture on Chapter Six: Recruitment of Human Resources	20 minutes	transparencies (as required)	blackboard, overhead projector
	2	Identification of variables to be used in constructing a systems model for this chapter.	10 minutes		
	3	In-class assignment of Practice Set Exercise #5	25 minutes	handout exercise #5	
	4	In-class review of Exercise #5	20 minutes	handout figure #4	
	5	Brief overview of next lecture (composite of the systems descussed from Chapters 4, 5, and 6 into one intergrated system.)	5 minutes		
7	1	General discussion of how the three systems integrate into one larger system and the synergism that results from their combined interactions.	80 minutes		

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APPENDIX F

Examinations

1. Part I: Objective Examination
2. Part II: Essay Examination

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PERSONNEL MANAGEMENT ADB 211
Prof. J. K. Evans - Exam 1 Fall 1987

Part I

"Please read the following instructions before attempting to answer these objective questions."

INSTRUCTIONS

There are 50 Multiple Choice questions on this part of the exam. Please read each questions carefully. Allow approximately minutes to finish this section.

Multiple Choice (questions 1 - 40) SECTION A

1. Which one of the following business planning activities has the potential to most influence human resource planning ?
   a) operational
   b) marketing
   c) strategic
   d) tax
   e) recreational

2. An external cause of demand for human resources in the future is:
   a) production forcasts.
   b) competitors
   c) budgets
   d) deaths
   e) new products

3. A technique used to forecast human resource needs which involves the extending past rates of change into the future is called:
   a) indexation
   b) delphi
   c) statistical analysis
   d) computer modeling
   e) extropolation

4. The most sophisticated approaches to human resource planning use:
   a) new-venture analysis
   b) extropolation
   c) indexation
   d) delphi
   e) computer modeling

5. Most employers initially respond to a human resource surplus by:
   a) retirement on a voluntary basis
   b) a hiring freeze
   c) layoffs
   d) discharges

6. An awareness that a labor shortage exists in a company could cause all of the following measures to be used to correct the situation except:
   a) recruitment
   b) overtime
   c) training
   d) early retirement

7. When a company summarizes each of its employers education, skills, abilities, ect., it is conducting a :
   a) human resource audit
   b) budget analysis
   c) affirmative action survey
   d) staffing survey
   e) external analysis

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8. Each of the following is an exgenous (external) factor which could impact future human resource needs except:
   a) economic forcasts
   b) labor forcasts
   c) business plans
   d) training forcasts

9. The action least likely to be taken in order to relieve a labor surplus is:
   a) demotions
   b) layoffs
   c) early retirement
   d) overtime
   e) terminations

10. When a labor surplus occurs and employers are discharged, the blow may be softened through the use of:
   a) attrition technique
   b) outplacement
   c) no growth attitudes
   d) affirmative action
   e) demographics

11. The use of repeated surveys and summaries in order to gather expert opinions for the purpose of assessing future human resource needs is called:
   a) indexation
   b) a survey
   c) extrapolation
   d) delphi technique
   e) instant forecast

12. The difference between the amount of human resources available and the quantity needed is referred to as the :
   a) exogenous factor
   b) endogenous factor
   c) labor variance
   d) uneven effect
   e) attrition

13. A current factor which impacts the availability of external labor supplies is called:
   a) demographics
   b) zero population growth
   c) affirmative action
   d) indexation
   e) politics

14. An activity which systematically forecasts an organizations future supply of, and demand for, employees is called:
   a) people constraints
   b) external challenges
   c) strategic plans
   d) human resource planning
   e) affirmative action

15. Which of the following will most likely provide the quickest notice of short-run changes in human resource requirement?
   a) strategic plans
   b) sales and production forecasts
   c) budgets
   d) new ventures

16. Knowledge about jobs and their requirements is collected through a systematic activity known as:
   a) job specification
   b) job identification
   c) job analysis
   d) job description
   e) job redesign

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17. A written statement that explains the duties, working conditions, and other aspects of a specified job is called the:
    a) job redesign
    b) job description
    c) job specification
    d) job identification
    e) job standard

18. Job specifications are primarily used to:
    a) describe what the job does
    b) describe the job demands and human factors required
    c) provide a profile of the job
    d) conduct job analysis activities

19. A job specification may require all of the following human characteristics except:
    a) sense of humor
    b) experience
    c) training
    d) physical demands
    e) mental demands

20. The factor that most intemately involves the workers sense of satisfaction on the job is:
    a) fringe benefit policy
    b) pay
    c) effective human resource planning
    d) the nature of the job

21. The correct design or redesign ofthe job must consider all of the following elements except:
    a) Organizational
    b) Environmental
    c) Compensational
    d) Behavioral

22. The element of job design that attempts to identify every task in a job in order to minimize time and effort is:
    a) work practices
    b) mechanistic approach
    c) variety
    d) work flow

23. Behavior job elements include all of the following except:
    a) social expectations
    b) autonomy
    c) variety
    d) task identity and significance
    e) feedback

24. The traditional manner in which a job is performed represents:
    a) job standards
    b) task identity
    c) work flow
    d) work practices

25. When personnel specialists believe that jobs are not specialized enough, they engage in:
    a) job rotation
    b) work flow
    c) evaluation
    d) satisfaction
    e) work simplification

26. Appropriate job description can assist human resource specialist in the identification of:
    a) organization problems
    b) job families
    c) work flow
    d) tradition
    e) employee morale

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27. A reduction of job fatigue is closely related to:
    a) pay
    b) task identity
    c) variety
    d) feedback

28. The behavioral element of job design that is most clearly associated with recieving guidance is:
    a) autonomy
    b) feedback
    c) values
    d) social expectations

29. With extreme specialization, satisfaction drops because there is a:
    a) low level of frustration
    b) a high level of autonomy
    c) low level of task identity
    d) high level of variety

30. A job redesign that increases the number of job-related tasks is called:
    a) vertical loading
    b) planning
    c) control
    d) horizontal loading

31. A reduction in the flow of new people and ideas throughout an organization could be caused by:
    a) compensation policies
    b) employment status policies
    c) promote from within policies
    d) international hiring policies

32. Each of the following acts as a restraint on the recruitment process except:
    a) human resource plans
    b) affirmative action plans
    c) organizational policies
    d) needs analysis

33. Specialized workers are more difficult to recruit than unskilled workers. This primarily represents:
    a) job requirements
    b) recruiter habits
    c) employee referrals
    d) poor recruiting practices

34. The correctness of human resource staffing levels will have a direct impact on:
    a) recruiter efficiency
    b) production efficiency
    c) recruiter habits
    d) compensation

35. Which of the following is identified as an environmental condition which may strongly affect recruitment:
    a) organizational policies
    b) human resource plans
    c) labor laws
    d) job requirements

36. Recruitment of engineers at minority and womens' colleges is an example of activity which may be necessary to meet organizations:
    a) compensation plans
    b) affirmative action plans
    c) diversification plans
    d) capitalization plans

37. Secretly advertizing for a recruit to replace an incombent employee would be called a:
    a) want ad
    b) head hunter
    c) walk-in
    d) blind add

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38. A document which summarizes an applicant's working background, but does not collect the information in a uniform manner is called:
    a) job application blank
    b) want-ad
    c) blind add
    d) vita or resume

39. "Head hunters" refers to recruiting through the use of:
    a) professional search firms
    b) private placement agencies
    c) professional associations
    d) temporary help agencies

40. A payment of 10% of the first year's salary is associated with:
    a) state employment and security agencies
    b) private placement agencies
    c) temporary help agencies
    d) professional search firms

SECTION B--(questions 41 - 50)

41. The future demand for employees is essentially derived from the:
    a) supply of external employees
    b) demand for the firm's products and/or services
    c) competative forces in the labor market
    d) changes in Federal legislation

42. A well designed employee orientation program (which begins with the employment interview) will not include:
    a) realistic job previews
    b) early attempts to alleviate feelings of anxiety
    c) an honest explanation of the job
    d) a presentation of the employer through "rose colored glasses"

43. The primary problem associated with newspaper advertisements as a recruiting method is the:
    a) excessive costs
    b) excessive responses from unqualified applicants
    c) lack of coverage
    d) limited application to various type jobs

44. What type of information best characterizes job description:
    a) duties and responsibilities
    b) qualifications
    c) performance standards
    d) quantitative

45. Job analysis data are of critical importance in each of the following areas except:
    a) training and development
    b) test development
    c) performance appraisal
    d) strategic planning

46. The first stage of human resource planning involves an examination of:
    a) retirements
    b) promotions
    c) organizational objectives and plans
    d) the external environment

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47. The most difficult problem in forecasting demand for employees is:
    a) determining the supply of human resources
    b) determining the relationship between personnel demand and the firm's output
    c) estimating turnover patterns
    d) forecasting internal supply

48. Which of the following statements relative to recruitment is true:
    a) a majority of firms evaluate the performance of their recruiters
    b) campus interviews are normally conducted by trained people
    c) initial interviews normally utilize highly objective methods
    d) interviewers attempt to evaluate hard to measure areas such as ambition and interpersonal skills

49. Which type of psychological test measures a persons overall ability to learn:
    a) aptitude test
    b) interest
    c) personality
    d) specific abilities

50. In order to take advantage of the investment firms have in their human resources, effective promotion procedures will include each of the following except:
    a) making vacancy information known to potential candidates
    b) motivating candidates to apply
    c) limiting the announcement to the job family of the open position
    d) evaluating the suitability of candidates

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PART II

"Please read the following instructions before attempting to answer this essay question."

INSTRUCTIONS

It should take you approximately 50 minutes to complete this question. Please read the question in its entirety so that you may fully understand what you are being asked to do before any attempt is made to provide answers. Take time to organize your thoughts on how you will answer the questions before starting to write. It is very important to deal with each part of the question in the same order in which it is presented. Failure to do this will make your response appear confused and thus be difficult to grade.

Essay Question

Human resource planning is a means by which organizations attempt to achieve maximum utilization of people (the labor factor) which contribute to the achievement of goals and objectives which will hopefully make a company successful. Simply stated: "The goal of effective human resource planning is to have the right people, in the right place, at the right time, in the right quantity, and the right costs." With these facts in mind, please answer the following question based on your knowledge of the subject.

Ajax Industries, a large manufacturer of electronic components has recently expanded its product line in order to meet the needs of competition and hopefully gain a larger share of the market for high-tech products. As a result of this action, the company has experienced some serious labor shortage problems. There is also a growing awareness that the present employees do not possess the job skills required to meet the expected challenges of the future that will encompass a range of both technological and managerial areas.

As the newly appointed Human Resource Manager of this company, it is your responsibility to make sure that Ajax has the people power necessary to meet all of its requirements. It is obvious to you that future human resource planning must include a proactive rather than a reactive managerial style. Because of your training in human resource management techniques, an immediate needs assessment of present staffing levels and talent must be conducted to identify the magnitude of this problem before any corrective action may be taken.

Please answer the following:

1) Give examples of two assessment techniques that could be used to help identify present and future resource needs. Compare the good and bad features of each example.

2) Give examples of possible action which could be taken to alleviate the above mentioned labor shortages and discuss how this would happen.

3) Predict what would happen if the above mentioned labor shortages were over corrected and suggest appropriate corrective action.

4) What is the role of Job Analysis and Job Design in human resource planning activities? Give some reasons to support your answer.

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APPENXIX G

Criteria For Good Examination Design

1. Section A: Objective Examination
2. Section B: Restricted Response Essay Examination

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SECTION A

Objective Examination (questions 1-40)

This test is designed to measure student leaning outcomes at the level identified in Blooms' Taxonomy of Educational Objectives as Knowledge. The following guidelines have been used to provide specific maxims for this purpose and were adhered to in the construction of all multiple-choice items. They are:

1) The stem of the item (question) should be meaningful by itself and present a definite probelm.
(A properly constructed multiple-choice item presents a definite problem in the stem, which is meaningful without alternatives.)

2) The item stem should include as much of the item as possible and should be free of irrelevent material.
(This will increase the probability of a clearly stated problem in the stem and reduce the reading time required.)

3) Use a negatively stated stem only when significant learning outcomes require it.
(Although negatively stated items are generally to be avoided, there are occassions where they are useful.)

4) All of the items should be grammatically consistent with the stem of the item.
(The main function of this requirement is to prevent irrelevant clues from creeping into the items.)

5) An item should contain only one correct or clearly best answer.
(Including more than one correct answer in a test item is tantamount to asking pupils to provide a mental response of true or false to each alternative rather than a comparison and selection of alternatives.)

6) Items used to measure understanding should contain some novelty but beware of too much novelty.
(The situation must be new to the pupil, but not too far from the illustrations used in class.)

7) All distracters should be plausible.
(The purpose of the distracter is to distract the uninformed away from the correct answer.)

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8) Verbal associations between the stem and correct answer should be avoided.
(Frequently a word in the correct answer will provide an irrelevant clue because it looks or sounds like a word in the stem of the item.)

9) The relative length of the alternatives should not provide a clue to the answer.
(Where the correct answer cannot be shortened, the distracters can be expanded to the desired length.)

10) The correct answer should appear in each of the alternative positions approximately an equal number of times, but in random order.
(The tendency to bury the answer in the middle of the list of alternatives should be avoided.)

11) Use special alternatives such as "none of the above" or "all of the above" sparingly.
(Both types of responses prevent the item from functioning as intended.)

12) Do not use multiple-choice items where other item types are more appropriate.

*Questions 41-60 on this multiple-choice, objective examination were taken directly from the Personnel Accreditation Institute (PAI) certification test. An examination of their content and format has found them to be consistent with the above mentioned criteria for well-designed tests.

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SECTION B

Restricted Response Essay Examination

This examination is designed to measure student learning outcomes at the levels identified in Bloom's Taxonomy of Educational Objectives as Analysis, Synthesis and Evaluation. These have previously been identified for the purpose of definition as being outcomes that are frequently associated with the operationalization of the construct known as "critical thinking." The following guidelines have been used to assist in the appropriate construction of a restricted-response essay question. They are:

1) Have clearly in mind what mental processes you want the students to use in answering before starting to write the question.
(As stated above, the questions on the examination will attempt to elicit the activities of analysis, synthesis, and evaluation of data that directly relates to that part of the course content under study for the purpose of conducting this research.)

2) Use novel material or organization of material in phrasing essay questions.
(Students are put in a hypothetical situation where they must do more than merely respond to, or reproduce, the material as it appeared in the text and classroom lecture.)

3) Start essay question with such words as "Compare," "Contrast," "Give reasons for," "Give examples of," "Explain how," "Predict what would happen if," "Criticize," "Differentiate," "Illustrate."
(The use of words or phrases such as these, combined with novel material, will help to present tasks requiring students to select, organize, and use their knowledge.)

4) Write the essay question in such a way that the task is clearly and unambiquously defined for each examinee.
(The objective is to ascertain that the score a student gets is a reflection of how well he or she can do a specified task, not how well he or she can figure out what the task is supposed to be.)

5) A question dealing with a controversial issue should ask for and be evaluated in terms of the presentation of evidence for a position, rather than the position taken.
(In this type of question the teacher should not grade the student on the position he or she takes, but only on the basis of how well they defend of support their position.)

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6) Be sure that the essay questions really ask for the behavior that you really want the student to display.

7) Adapt the length and complexity of the question to the maturity level of the students.
(The question should not be too elaborate, to conceptually sophisticated, or too long for the students being tested to anwser.)

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APPENDIX H

Topic Matrix: Learning Content To Examination Questions

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TABLE H-1

MATRIX OF CONTENT AREAS COVERED DURING RESEARCH EXPERIMENT TO QUESTIONS USED ON EVALUATION EXAMINATIONS

Chapter 4 - Learning Content	Part I Objective Examination Multiple-Choice Question #														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A. Human Resource planning activity	x			x								x		x	x
B. Organizational demand for human resources		x				x	x	x			x	x	x		
C. Planning strategy	x				x		x	x					x	x	x
D. Forecasting techniques			x	x										x	x
E. Solutions to shortage and surplus management of human resources					x	x			x	x					

Chapter 5 - Learning Content	Part I Objective Examination (Cont.) Multiple-Choice Question #														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A. Job analysis information	x	x		x	x			x	x	x		x	x	x	
B. Job description and specification	x	x	x								x	x	x		
C. Consideration in job designs	x		x			x	x	x	x	x		x	x	x	
D. Job-redisign techniques						x									x
E. Information systems and personnel activities										x					

Chapter 6 - Learning Content	Part I Objective Examination (Cont.) Multiple-Choice Question #									
	31	32	33	34	35	36	37	38	39	40
A. Human resource planning for effective recruitment	x		x			x			x	
B. Constraints of the recruitment process	x	x		x	x	x				
C. Finding and attracting recruits			x	x		x	x	x	x	x

Personnel Accrediting Institute	Part I Objective Examination (Cont.) Multiple-Choice Question #									
(selectively applicable to any of the above content areas)	41	42	43	44	45	46	47	48	49	50
	x	x	x	x	x	x	x	x	x	x

Chapters 4, 5, and 6 Learning Content	Part II Restricted Response Essay Examination			
	Part 1	Part 2	Part 3	Part 4
Chapter 4 (A, B, C, D, E)	A, D	A, E	A, B, C, E	
Chapter 5 (A, B, C, D, E)		E		B, C, D
Chapter 6 (A, B, C)				A

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APPENDIX I

Writing Analysis

1. Writing Sample
2. Writing Evaluation Criteria
3. Writing Score Sheet

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WRITING SAMPLE

In order to better understand and serve the needs of students taking this course in Personnel/Human Resource Management, I am requesting that you write a brief, one-page response to the question listed below. It is the intent of this course, and hopefully all others taught here at NHC, to be concerned with the expectations of its students in order to facilitate the learning process.

Please sign the attached sheet which has been provided for your answer.

"What are some of the important issues in the areas of people management that you would like to learn more about while taking this course, and how do you feel that this will help you in the pursuit of a successful career?"

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NAME

RESPONSE:

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Diederick: Writing Evaluation Criteria

IDEAS AND INFORMATION

High: The student has given some thought to the topic and writes what he/she* really thinks. She discusses each main point long enough to show clearly what she means. She supports each main point with arguments, examples, or details; she gives the reader some reason for believing it. Her points are clearly related to the topic and to the main idea or impression she is trying to convey. No necessary points are overlooked and there is no padding. She answers all parts of the question.

Middle: The paper gives the impression that the student does not really believe what she is writing or does not fully understand what it means. She tries to guess what the teacher wants and writes what she thinks will get by. She does not explain her points very clearly or make them come alive to the reader. She answers some, but not all parts of the question.

Low: It is either hard to tell what points the student is trying to make or else they are so silly that, if she had only stopped to think, she would have realized that they made no sense. She is only trying to get something down on paper. She does not explain her points; she only asserts them and then goes on to something else, or she repeats them in slightly different words. She does not bother to check her facts, and much of what she writes is obviously untrue. No one believes this sort of writing - - not even the student who wrote it.

ORGANIZATION

High: The paper starts at a good point, has a sense of movement, gets somewhere, and then stops. The paper has an underlying plan that the reader can follow; she is never in doubt as to where she is or where she is going. Sometimes there is a little twist near the end that makes the paper come out in a way that the reader does not expect, but it seems quite logical. Main points are treated at greatest length or with greatest emphasis, others in proportion to their importance.

Medium: The organization of this paper is standard and conventional. There is usually a one-paragraph introduction, three main points each treated in one paragraph, and a conclusion that often seems tacked on or forced. Some trivial points are treated in greater detail than important points, and there is usually some dead wood that might better be cut out.

Low: This paper starts anywhere and never gets anywhere. The main points are not clearly separated from one another, and they come in a random order - - as though the student had not given any thought to what she intended to say before she started to write. The paper seems to start in one direction, then another, then another, until the reader is lost.

*After this, we will use she throughout.

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WORDINC

High: The writer uses a sprinkling of uncommon words or of familiar words in an uncommon setting. She shows an interest in words and in putting them together in slightly unusual ways. Some of her experiments with words may not quite come off, but this is such a promising trait in a young writer that a few mistakes may be forgiven. For the most part, she uses words correctly, but she also uses them with imagination.

Middle: The writer is addicted to tired old phrases and hackneyed expressions. If you left a blank in one of her sentences, almost anyone could guess what word she would use at that point. She does not stop to think how to say something; she just says it in the same way as everyone else. A writer may also get a middle rating on this quality if she overdoes her experiments with uncommon words: if she always uses a big word when a little word would serve her purpose better.

Low: The writer uses words so carelessly and inexactly that she gets far too many wrong. These are not intentional experiments with words in which failure may be forgiven: they represent groping for words and using them without regard to their fitness. A paper written in a childish vocabulary may also get a low rating on this quality, even if no word is clearly wrong.

TONE AND AUDIENCE AWARENESS

High: The writing sounds like a person, not a committee. The writer seems quite sincere and candid, and she writes about something she knows, often from personal experience. You could not mistake this writing for the writing of anyone else. Although the writer may assume different roles in different papers, she does not put on airs. She is brave enough to reveal herself as she is. The tone of the piece is appropriate for the approach to the topic taken. In the case of the Winn response, the writer speaks with the authority of someone who either has immediate information/point of view to share or someone who is willing to explore whatever her background information is, in order to answer the question. The writer might even state that she does not have ready answers but then uses the writing effectively to problem solve and come to some conclusions. The writer shows awareness of her audience by clearly defining any unusual, general or ideosyncratic terms, by covering only a bit of material at any one time and by being specific.

Middle: The writer usually tries to appear better or wiser than she really is. She tends to write lofty sentiments and broad generalities. She does not put in the little homely details that show she knows what she is talking about. Her writing tries to sound impressive. Sometimes it is impersonal and correct but colorless, without personal feeling or imagination. The tone of the piece may shift from being extremely appropriate for the approach to the topic taken, to being somewhat inappropriate at times. The writer defines some but not all of her terms; sometimes she covers too much material without explanation.

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Low: The writer reveals herself enough but without meaning to. Her thoughts and feelings are those of an "uneducated" person who does not realize how bad they sound. Her way of expressing herself differs from standard English, but it is not her personal style; it is the way uneducated people talk in her neighborhood. Sometimes the unconscious revelation is so touching that we are tempted to rate it high on Tone/Audience Awareness, but it deserves a high rating only if the effect is intended. The writer is essentially writing "writer-based" rather then "reader-based" prose. Ideosyncratic words are used without definition; whole concepts, events, etc. are named but are not described nor explained.

MECHANICS

High: There are no vulgar or "illiterate" errors in usage by present standards of informal written English, and there are very few errors in points that have been discussed in class. The sentence structure is usually correct, even in varied and complicated sentence patterns.

There are no serious violations of rules that have been taught- - except slips of the pen. Note, however, that modern editors do not require commas after short introductory clauses, around nonrestrictive clauses, or between short coordinate clauses unless their omission leads to ambiguity or makes the sentence hard to read. Contractions are acceptable - - often desirable.

Descriptions of spelling levels are most often used in grading test papers written in class. Since there is insufficient time to make full use of the dictionary, spelling standards should be more lenient than for papers written at home. The high paper may have some misspellings, and these would occur more in words that are hard to spell. The spelling is consistent; words are not spelled correctly in one sentence and misspelled in another - - unless the misspelling appears to be a slip of the pen.

The handwriting is clear, attractive, and well spaced, and the rules of manuscript form have been observed.

Middle: There are few serious errors in usage and several in points that have been discussed in class but not enough to obscure meaning. The sentence structure is usually correct in familiar sentence patterns but there are occasional errors in complicated patterns; errors in parallelism, subordination, consistency of tenses, reference of pronouns, etc.

There are several violations of rules that have been taught - - as many as usually occur in the average paper. (Counts of such errors in high, middle, and low papers at various ages and socioeconomic levels would be desirable in order to establish standards.)

There are several spelling errors in hard words and a few violations of basic spelling rules, but no more than one finds in the average paper. (Spelling standards differ so sharply from grade to grade and from one socioeconomic

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level to another that each school would do well to make a distribution of spelling errors per hundred words (at least for test papers written in class) and relate its ratings to this distribution.)

The handwriting is average in legibility and attractiveness. There may be a few violations of rules for manuscript form if there is evidence of some care for the appearance of the page.

Low: There are so many serious errors in usage and sentence structure that the paper is hard to understand. Basic punctuation is omitted or haphazard, resulting in fragments, run-on sentences, etc. There are so many spelling errors that they interfere with comprehension. The paper is sloppy in appearance and difficult to read.

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WRITING SCORE SHEET FOR HUMAN RESOURCE MANAGEMENT STUDENTS

Student Name_____

Date_____Class Section_____

Scorer's Name_____

PERSONAL NARRATIVE CHOICE #	Low		Middle		High
Ideas and Information	2	4	6	8	10
Organization	2	4	6	8	10
Tone and Audience Awareness	2	4	6	8	10
Wording	1	2	3	4	5
Mechanics	4	8	12	16	20

Total_____out of 55

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APPENDIX J

Writing Analysis Evaluation

1. Evaluation Format For Scoring Restricted Response Essay Questions
2. Scoring Sheet For Essay Questions

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Evaluation Format For Scoring Restricted Response Essay Questions

It is generally recognized that the essay test is the best way to measure learning outcomes that cannot be measured by any other means. However, a most serious limitation often encountered when using this method of testing is the unreliability of scoring. It is with this fact in mind that maximum effort be made to enhance this reliability by clearly defining the learning outcomes to be measured; properly framing questions; and carefully establishing scoring rules to be followed during the evaluation process. The implementation of a set procedure for scoring the results will help to ensure this reliability.

(Gronlund 1971) suggests that restricted response essay questions can generally be satisfactorily scored by the point method. The restricted scope and limited number of characteristics included in a single answer make it possible to define degrees of quality sufficiently precise to assign point values. With this in mind, a Likert type scale will be used to measure the learning outcomes under study. When scoring the essay questions, the following considerations should be applied to the fullest extent possible:

1. The object of this exercise is to measure learning outcomes; therefore, a number of factors which would normally influence our evaluation of essay questions will be overlooked because they are not pertinent to the purpose of this study.

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They are: A. Legibility of handwriting

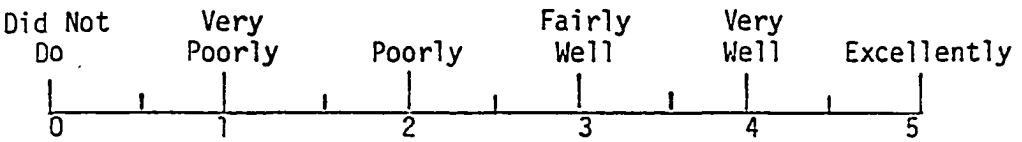
B. Spelling

C. Sentence structure

D. Punctuation

E. Neatness

2. Each answer will be read in its entirety before there is any attempt to apply a score or to measure the learning outcomes. When this is completed, each part of the required answer will be individually measured against the Likert scale (see below), in the sequence given, for purposes of determining the degree of achievement.



3. The Likert scale being used provides a scoring range of 0 to 5 points. One-half point increments may be used to assign values up or down the scale; however, one-quarter point increments shall not be used (e.g. 1.5 or 2.5 etc., but not 1.25 nor 1.75 etc.)

4. After all parts of the answer have been evaluated, the scores will then be totalled to provide a cumulative measure of the learning outcome.

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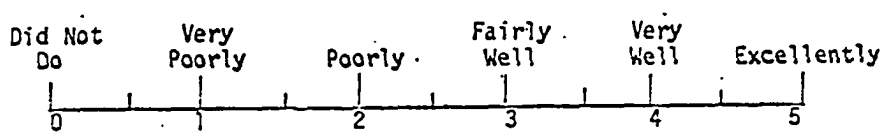
Scoring Sheet For Essay Questions

In order to maintain an unbiased posture and consistency while scoring the answers to the essay question, the following outline will be used for the purpose of evaluation. Each response shall be judged to be in one of the achievement ranges defined below. They are:

0) Did Not Do	- No valid attempt was made to answer this question
1) Very Poorly	- The response to the question appeared for all intents and purposes to be only a guess.
2) Poorly	- The answer gave some vague hint of knowledge but would be deemed inadequate.
3) Fairly Well	- A reasonable grasp of the knowledge required to answer the question is displayed.
4) Very Well	- Thorough knowledge of the answer is exhibited with only minor omissions in content.
5) Excellently	- Complete understanding and knowledge of the answer is displayed in a relational context that shows mastery of the material.

1. List two of the many assessment techniques that could be used to provide valuable information for use in human resource planning and briefly explain what these techniques are.



#1

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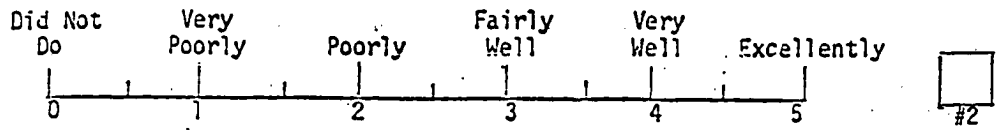
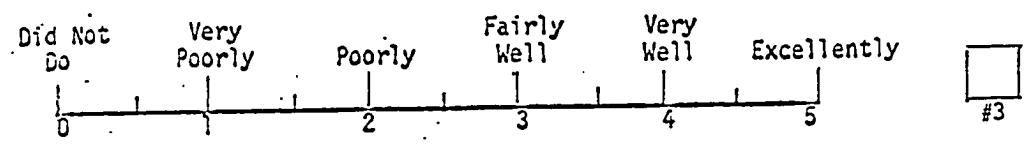
Answer Guide: Students should select two techniques from the following list. They are: A) Delphi Survey, B) Extrapolation, C) Indexation, D) Personnel Data, or E) Computer/other statistical models. They should discuss the kind of information that would be provided by their choice of examples and how it could assist future planning activities. (e.g. Indexation - a method of short run needs projection that matches employment growth to selected economic indicators.) For example, planners may discover that (X) dollars increase in sales requires (X) number of direct labor personnel.

2. What actions would be appropriate to relieve the above mentioned shortages?



Answer Guide: A discussion of this part of the question should include recognition and understanding of the three principle factors which affect labor variance in order to alleviate shortages. They are: 1) recruitment, 2) training, and 3) overtime.

3. Explain how over-correction of the problem without adequate planning for future needs would cause a surplus of labor to exist, and what actions would have to be taken to correct the situation.



Answer Guide: This part of the question requires that the student discuss how the excess activity to correct shortages unwittingly cause surpluses which must then be dealt with through a different set of corrective actions which include layoffs, early retirement, terminations, demotions, etc. The student should also note and discuss the dynamic nature of labor variance problems as they relate to the need for effective human resource planning.

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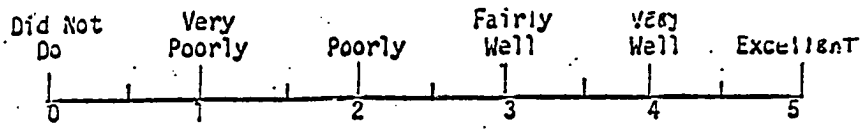
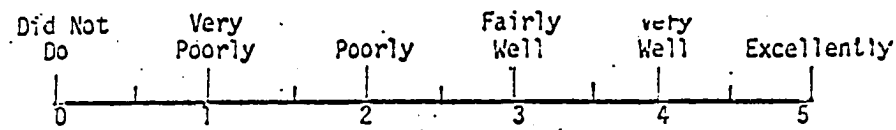
4. Is it possible that a lack of Job Analysis and Job Design could have contributed to the problem. If so, explain how. If not, explain why.



#4

Answer Guide: The answer to this portion of the question evolves around the fact that job analysis provides information that can be used in job design. In turn, this facilitates good job descriptions and specifications. It should also be noted that without this information difficulties arise in determining how many people are needed to do certain jobs and what their qualifications should be. Analysis may also be given as to how design and specification may impact the workforce and help to create shortage and surplus situations. (e.g. Poorly designed jobs cause people to have morale problems and thus higher turnover rates occur.) Also, improperly specified jobs create differentials between the skills needed and the skills possessed by employees.

5. Evaluation of syntax.



#5

Does the student present his or her overall answer to the essay in a logically constructed manner which avoids ambiguity and attempts to provide information in the order in which it was requested?

Total score for evaluation of questions 1 through 5:

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APPENDIX K

Raw Data

1. Control Group (TABLE K-1)
2. Experimental Group (TABLE K-2)

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TABLE K-1

Raw Data: Control Group

#	GPA	W SAMP	RRE	O-PRE-T	O-PT-T	N/B A	CTA(A)	CTA(B)
1	2.28	51	13.5	52	70	80	54	54
2	2.93	24	15	50	70	76	58	59
3	2.96	37	8	34	54	62	52	37
4	3.24	47	20.5	56	78	82	49	60
5	2.43	27	15	48	64	72	56	49
6	2.6	28	21	54	68	74	58	53
7	2.29	23	13	42	52	66	48	0
8	2	28	13	56	72	76	44	55
9	2.03	43	12.5	48	64	76	64	0
10	2.88	23	12.5	48	78	78	50	55
11	2.93	27	14	50	58	64	60	62
12	2.67	42	14	54	72	78	56	57
13	2.67	31	16	66	70	78	61	0
14	2.5	20	11.5	54	66	66	41	49
15	2.67	38	13	46	82	86	48	60
16	2.67	31	16.5	62	82	86	52	47
17	3.82	47	19.5	72	84	88	72	64
18	2	39	14	52	70	72	52	53
19	2.27	37	19	58	70	80	55	48
20	2.4	51	18.5	62	82	88	49	55
21	2.03	36	15	46	76	82	53	51
22	3.2	22	14.5	50	76	78	44	47
23	3.37	45	9.5	48	76	80	55	59
24	2.99	42	21.5	66	80	86	65	66
25	3.75	37	25	62	80	84	63	64
26	2.43	25	15	44	60	68	50	46
27	2.1	31	14	30	54	70	41	52
28	2.3	42	11	46	58	68	57	53
29	1.93	22	12	50	54	62	59	0
30	3.2	42	16.5	42	72	80	48	52
31	2	34	14	44	70	76	42	52
32	2.91	30	19.5	68	74	74	68	60
	2.6391	34.438	15.234	51.875	69.875	76.125	53.875	54.25

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TABLE K-2
Raw Data: Experimental Group

#	GPA	W SAMP	RRE	O-PRE-T	O-PT-T	N/B A	CTA(A)	CTA(B)
1	3.58	38	24.5	58	88	88	59	51
2	2.6	45	19	42	68	84	49	45
3	2.11	35	18.5	56	64	72	61	58
4	3.21	41	16	60	80	80	64	65
5	3.3	24	19	56	86	86	58	56
6	1.67	41	18.5	60	66	74	59	0
7	1.83	31	18.5	34	56	68	61	61
8	2.63	34	19.5	62	74	84	58	62
9	2.63	34	18.5	48	84	86	49	63
10	3.87	32	22.5	74	84	92	71	66
11	3.38	55	14.5	58	78	84	65	67
12	2.02	46	18.5	50	68	74	59	64
13	3.27	49	21	58	74	84	69	68
14	3	21	18	36	80	86	55	0
15	2.4	48	21	56	72	80	47	53
16	2.12	16	18.5	28	58	64	50	42
17	2.93	26	22	48	84	88	64	67
18	1.78	51	16	64	70	84	59	57
19	2.04	27	12	50	72	80	40	0
20	2	46	17	44	62	64	48	50
21	2.31	26	16	48	60	72	51	0
22	2.1	34	23.5	64	62	76	67	51
23	2.29	41	15	40	78	84	59	54
24	2.82	33	11.5	52	70	78	53	60
25	2.96	31	22.5	46	84	90	54	0
26	2.07	28	13	40	50	62	43	45
27	2.93	20	12.5	42	58	68	49	43
28	2.62	48	17	46	70	80	56	53
29	2.75	34	16	44	68	76	63	62
30	2.6	35	15.5	54	72	78	55	57
31	3.6	55	22	52	88	94	74	69
32	2.35	41	19	50	78	86	63	65
33	4	43	19.5	40	98	98	59	54
34	2.73	33	22	44	76	84	41	51
35	2.93	34	17	46	80	92	49	34
	2.6694	36.457	18.143	50	73.143	80.571	56.343	56.433

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APPENDIX L

Survey

1. Survey Questionnaire
2. Survey Results: Experminetal Group (TABLE L-1)
3. Survey Results: Supplement #1 (TABLE L-2)
4. Survey Results: Supplement #2

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SURVEY QUESTIONNAIRE

During the past four weeks, the members of this class in Human Resource Management have been introduced to the concept of "System Dynamics." As you are well aware, Chapters.4, 5, and 6 were chosen subject materials for the introduction of this methodology as a means of enhancing student understanding of the concepts contained therein.

In keeping with this exercise, I would greatly appreciate your thoughts and input as they relate to your feelings about this experience. (Please answer the following questions in a manner which you genuinely feel reflects your sentiments.) Thank you.

1. Do you feel that the System Dynamics approach to presenting topic materials was helpful to you in attempting to understand the chapters under study?

   A. ☐ Yes B. ☐ No C. ☐ Somewhat D. ☐ Not sure

2. Would you like to know more about the technique of "System Dynamics" as a means of understanding the relationship of various parts of a system (variables) to other parts (variables)?

   A. ☐ Yes B. ☐ No C. ☐ Not sure

3. Did you experience an increase in the apprehension level associated with learning when this method was first introduced in class?

   A. ☐ Yes B. ☐ No

4. If so, how would you classify this level of apprehension?

   A. ☐ High B. ☐ Moderate C. ☐ Low

5. How would you classify your apprehension level after the treatment had been completed?

   A. ☐ High B. ☐ Moderate C. ☐ Low D. ☐ None

6. Do you feel that this approach to learning (System Dynamics) helped you to understand the various concept variables under study?

   A. ☐ Yes B. ☐ No C. ☐ Not sure

7. Would you be interested in having other subjects or topic materials taught at New Hampshire College using this technique?

   A. ☐ Yes B. ☐ No C. ☐ Not sure

8. If so, what subjects do you feel could be more effectively taught by using this methodology?

   _____
   _____
   _____

9. How would you classify/rate your level of attention to the lectures being presented in class that incorporated "System Dynamics" technique?

   A. ☐ High B. ☐ Moderate C. ☐ Low

10. How does the above mentioned level of attention generally compare with your attentiveness in other classes?

    A. ☐ Same B. ☐ Different

11. Please list any comments about this in-class experience that you choose to make.

    _____
    _____
    _____
    _____

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TABLE L-1

SURVEY RESULTS - EXPERIMENTAL GROUP
(32 questionnaires were returned)

#	Questions	Answer	# Replies	%
1.	Do you feel that the System Dynamics approach to presenting topic materials was helpful to you in attempting to understand the chapters being studied?	Yes No Somewhat	16 1 15	(.50) (.03) (.47)
2.	Would you like to know more about the technique of "System Dynamics" as a means of understanding the relationship of various parts of a system (variables) to other parts (variables)?	Yes No Not Sure	18 13 10	(.58) (.10) (.32)
3.	Did you experience an increase in the apprehension level associated with learning when this method was first introduced in class?	Yes No	20 12	(.63) (.37)
4.	If so, how would you classify this level of apprehension?	High Moderate Low	0 20 2	(.0) (.90) (.10)
5.	How would you classify your apprehension level after the treatement?	High Moderate Low None	5 14 8 5	(.155) (.44) (.29) (.155)
6.	Do you feel that this approach to learning (Systems Dynamics) helped you understand the various concepts?	Yes No Not Sure	21 6 5	(.66) (.19) (.15)
7.	Would you be interested in having other subjects of topic materials taught at New Hampshire College using this technique?	Yes No Not Sure	6 7 18	(.19) (.23) (.58)
8.	If so, what subjects do you feel could be more effectively taught by using this methodology? (See attached sheet - Supplement #1)			
9.	How would you classify/rate your level of attention to the lectures being presented in class that incorporated "Systems Dynamics" technique?	High Moderate Low	13 16 3	(.41) (.50) (.09)
10.	How does the above mentioned level of attention generally compare with your attentiveness in other classes.	Same Different	13 19	(.41) (.59)
11.	Please list any comments about this in-class experience that you choose to make. (See attached sheet - Supplement #2).			

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TABLE L-2

SURVEY - SUPPLEMENT #1

(Ref. question #8)

Subject	Citation(s)
1. Economics	4
2. Accounting	1
3. Management	5
4. Computers	2
5. Introduction to Business	1
6. Human Relations	2
7. Business Communications	1
8. Marketing	3
9. Organizational Behavior	2
10. Psychology	2
11. Sociology	1
(Total)	24

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SURVEY - SUPPLEMENT #2

(Ref. question #11)

Comments:

(1) "I think that it was a helpful overall technique; however, I think we skimmed a lot of specifics which could have been touched upon stronger."

(2) "I don't think we were prepared well enough for the test. Class discussion was spent on other things."

(3) "Combining System Dynamics with reading and studying on your own was very helpful to me. It also opened up a new way of thinking (process) for me."

(4) "It was a good way to make sure that I knew the material being covered, by looking at the system and understanding the steps."

(5) "I felt that you got your point across that different variables affect different things, and that we must look at all of these things when studying certain material."

(6) "I found System Dynamics to be too slow, although it does come in handy at times. I am easily bored with repitition."

(7) "This class would have been better if everyone in the class participated in the lecture, not just the teachers favorites."

(8) "I took this course last year with you and dropped it. This class is run much better now because it forces students to be prepared."

(9) "Radical."

(10) "I feel that the chapters should have been reviewed somewhat before the technique of System Dynamics was introduced."

(11) "Good idea in theory. Could tie it in closer to materials in book. In other words, stop every so often while doing the systems and go through appropriate sections in the book in more depth then you did."

(12) "Too much time was spent doing this. Maybe if you gave just one or two examples, it would be OK rather than concentrating all of the time that you did on it."

(13) "It was a rewarding experience. It is something that I would most likely use in my future endeavors where I need to understand cause-effect relationships."

(14) "Brought to light an entirely new way of looking at and dealing with problems/situations. It's organized better and saves a lot of time and energy."

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(15) "Do more small scale models before getting into larger ones."

(16) "This was something different from other classes and because of that, I did spend more time on it. In this way, I did learn more by using it."

(17) "I think that the exercise was good and could teach a lot. Most students don't like to be different in class, so they won't speak out. Me included."

(18) "It helped us to see how different variables can be incorporated into a system. This "breaking down" of a system allows one to be more flexible in the future when dealing with the identification of variables in a system and how they should be used."

(19) "I felt that it made you think, but that you had to discipline yourself to read the material in order to understand."

(20) "I felt that it was interesting, but also felt that it really didn't teach us things in the chapters. It explained how they related, not what they were. I don't think I would do it again."

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