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I am submitting herewith a dissertation written by Ardis M. Rewerts entitled "An Ecosystem Framework for Studying Competence Development." I recommend that it be accepted in partial fulfillment of the requirements for the of Doctor of Philosophy, with a major in Home Economics.

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A Dissertation

Presented for the

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Degree

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Ardis M. Rewerts

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ABSTRACT

The purpose of this study was to present a model depicting competence development as multidimensional and occurring in a holistic framework. An ecosystem theoretical framework was used. Specifically, two models were developed. One model represents the dynamic aspects of learners as systems in constant interaction with their environments. The interrelationships and increasing complexity of content and process competence development are depicted in the second model.

The procedure for fulfilling the purpose of the research was a four-stage process. Three factors considered relevant in studying competence development--individualization, behavioral objectives, and criterion-referenced assessment--were studied and interpreted from several theoretical and philosophical perspectives. The structure and process of competence development were interpreted from an ecosystem theoretical base. The models were presented to 10 judges in the fields of home economics/human ecology, teacher education, and curriculum and instruction for initial construct validation. Finally, propositions and recommendations were stated in light of implications drawn from the models for use in general and specific areas of study. Key propositions included study of learner/system openness, learner/system boundary restrictions, feedback characteristics, and synergistic effects of subsystems and the suprasystem.

Home economics and, specifically, textiles and clothing were content areas used in explaining the use and function of the models. The unifying nature of system theory for understanding content and process

competence can be illustrated with a field of study which has implemented an ecosystem theoretical framework. The author's area of expertise is textiles and clothing.

The design of two competence development models represents a beginning for dealing with the complexities and changes in formalized education. Through application and further validation, these models should provide vehicles for helping to deal with the multidimensional aspects of developing competence.

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CHAPTER I

INTRODUCTION

Home economics has assumed a broad responsibility for the improvement of human welfare with an orientation to humans and their interaction with the near environment. Home economics research and curriculum are being viewed in this context. The research component of this multidimensional task has been described in terms of goals by the Association of Administrators of Home Economics in delineating National Goals and Guidelines for Research in Home Economics (1970). The continual updating of these goals is urged.

Home economics areas have confronted human problems continually. However, people are meeting an increasingly complex and highly technical environment supported or distorted by vast amounts of information, often with no perception of the effects of their individual actions on their private and public lives. Competence and responsibility are required in dealing with all of the intricacies of the near environment and should not be studied any longer solely in terms of product characteristics and personal values. The interrelationships among environmental components must be understood. And, people need a sense of being able to cope with continual change in themselves and their environments.

Undergraduate curricula should be designed to reflect the interdisciplinary and multidisciplinary implications of family and consumer problems and the importance of providing this perspective for the consumer to whom the knowledge is directed. At the same time, it must be

recognized that students learning about family problems come from diverse backgrounds and have diverse career goals. Consequently, there is a need to provide a well-based learning experience for each student which supplements the student's major area of interest, augments interdisciplinary competence, and gives the student competence in dealing with the dynamics of change. A strong interdisciplinary orientation is relevant particularly to students in professional careers because they will work directly or indirectly with the public as their students or as clients for whom an isolated view of problems is not always appropriate.

As knowledge grows through research and the variety of careers and interests dealing in some way with choices and responsibility expands, the educator must realize the impossibility of each student becoming an expert in all phases of a field. A learning environment which facilitates problem solving/decision making and continued updating, geared to a constantly changing society, is essential. The diversity of student educational backgrounds and interests must be recognized and accommodated in the light of change.

Widespread awareness exists among educators that education in general should be scrutinized in light of its relationship to societal changes. The evolving concept of competence development emphasizes the need for analysis of both individual student and societal needs. The literature in education indicates an increasing emphasis on identification of individual student needs in relation to instructional strategies. An assessment of the broad range of competence required of a student in a professional field such as home economics, coupled with the responsibility of providing instructional design conducive to the continued

development of varied and changing competence, provide bases for the development of a theoretical model which delineates the development of competence in the educational process. The model proposed is intended to conceptualize education for competence development as being multi-dimensional--determined by the combination of interactions of the specified learner and the environment.

Objectives of the Study

The overall purpose of this study is to construct a theoretical model based on a conceptual structure which depicts the developing complexity of competence. Particular emphasis will be given to the multidimensional influences on the learner's developing competence, thus, integrating the process and content elements--the aspirations and the attributes of the learner.

In the process of developing a theoretical model, its function and use will be clarified. Initial validation will be conducted. Implementation of the model will be described.

The study will provide a basis for continuing investigation of competence development in all learners and learning fields. It can provide a basis for analyzing existing practice and research. Hypotheses based on the model can facilitate the empirical validation of the model.

Justification of the Problem

It seems inevitable in a society requiring formalized learning by everyone that differences will exist in determining the structure and content of that requirement. The variation in vantage points of "experts" alone provides one source for controversy. One goal of all who educate

or are being educated could be that of developing competence. Competence, as defined in New Webster's Dictionary (1975), means "answering all requirements; suitable, fit; adequate; having legal capacity or lawfully belonging" (p. 324). However, as the term is variously interpreted in all levels and approaches to education, it takes on different meanings. Some interpretations of the word come under the coined term "competency," which represents the competency-based education (CBE) movement. Kidd and Natalicio (1972) stated that competencies are:

> . . . labels given to results of a comparison of a particular performance state of a process with a static performance standard or behavioral criterion. Competencies are inferences, then, and each competency is only inferentially related to the learning process from which the static comparison is derived. (p. 33)

Definitions from CBE emphasize an ability to do. White's (1959) concept of competence was developed to explain the effective interaction of a person in the environment.

One approach to assessing the merits of the concept as interpreted in the current CBE view of learning is to look at the several typical components of the movement. Behavioral objectives, criterion referencing, and individualization seem to be generally agreed upon as components. However, even the advocates of each of these, in or out of the CBE movement, have taken varying stands. These stands have spanned a continuum extending from interpretations by advocates of a behaviorist philosophy of education to those supporting a humanist approach to education.

Even with the volumes of research in education and learning and the never-ending technical advances in education, formal education is

under careful scrutiny and suffers criticism from all segments of society. Some concern arises from the fact that different educators speak from different conceptual bases--one basic dicotomy being education and subject matter. Different educators speak in the same terminology, but the words have different meaning. As the complexity of instruction and educational goals expand and evolve, the controversies have assumed a similar increase in complexity.

Those who have written of the complexities resulting from societal change and the accompanying need for educational change have insisted on a broader base for education than the current emphasis--one beyond a content orientation. Educators such as Hunt (1975); Frymier (1973); Schroder, Driver, and Streufert (1967); and Schroder (1971) encouraged the relevance of viewing education from an interactionist perspective. Jantsch (1975) has described a transactionist perspective. Proponents of interdisciplinarity as a research and educational concept relevant to a changing society support an integration of disciplines for dealing with societal problems. Berger (1972), in a report of the Centre for Educational Research and Innovation, defined "interdisciplinary" as

> . . . an adjective describing the interaction among two or more different disciplines. This interaction may range from simple communication of ideas to the mutual integration of organizing concepts, methodology, procedures, epistemology, terminology, data, and organization of research and education in a fairly large field. An interdisciplinary group consists of persons trained in different fields of knowledge (disciplines) with different concepts, methods and data, and terms organized into a common effort on a common problem with continuous intercommunication among the participants from the different disciplines. (p. 25)

With increased emphasis on the interdisciplinary approach to education as preparation for dealing with societal problems, the uniqueness of

competence in the interdisciplinary aspects of learning must be assessed.

Theorists and researchers in education have produced empirical data on the interaction of learners and their environments. Content specialists continue to contribute to the knowledge and sophistication of their fields. Society continues to increase in complexity, and we are reminded by people such as Toffler (1971) of the unrelenting nature of change.

Many educational models, learning models, and competence models have inspired careful analysis of the educational processes. However, a unified conceptual model of the interrelated aspects of competence development in a changing society seems to be missing. In particular, interactions among subject matter and learning process seem to be components missing in available models depicting competence development.

The model proposed is designed to provide a clearly defined conceptualization of the multidimensional aspects of competence development in a changing society. Just as theories and models of disciplinary subject matter development are not generalized among disciplines, theories and models of individual instruction cannot be generalized to group learning situations without considering certain unique features. Unique features must be viewed in a perspective appropriate to the learner and his/her current level of learner competence.

Educators in subject matter areas recognize the necessity of learners developing competence in the different fields of study, as we find such areas as science education, music education, and home economics education. As home economics assumes an ecological framework requiring interdisciplinary cooperation, the learning environment must undergo

adaptation to changing needs. The interaction between the two should be considered. Given the innovations and change up to now, we can expect a continuation of change in the needs and focus of education. The proposed model is meant not only to assess multidimensional competence development, but also to provide a unified conceptual framework within which such evolution in education can be evaluated.

Design of the Study

The development of a theoretical competence model is proposed in order to synthesize the factors considered operative in the development of competence. The factors basic to assembling the model beyond the overall concept of competency-based instruction include individualization of instruction, criterion-referenced assessment, and use of behavioral objectives. Each of these is noted in the literature as components of competency-based education. They have been given attention from outside the movement as well. Figure 1 below will be used as a guide in interrelating these concepts with educational theory and system theory.

	Parameters		
Theories	Individual-ization	Behavioral Objectives	Criterion-Referenced Assessment
Curriculum			
Instruction			
Learning			
System			

Figure 1. Factors for studying competence development.

The study was planned according to the following procedures:

1. Selected literature was reviewed concerning the structure, process, and content of education in order to identify concepts which provide a basis for developing a competence development model.

2. Models and concepts were reviewed which were considered relevant to the interrelationship of elements of competence development.

3. Ecosystem concepts were selected and interpreted from a multidimensional competence development perspective.

4. Models were constructed depicting multidimensional competence development based on ecosystem theory.

5. Suggestions and interpretations were given for application of the models.

6. An evaluation was conducted of the validity of the models. A structured opinionnaire was developed according to a format used by Vaines (1974). Suggestions were synthesized into a statement of recommendations for model usage.

7. Propositions were formulated, based on the models, which will facilitate validation of the model.

8. The models were interpreted within a specified student and subject matter field--textiles within home economics. An interdisciplinary context for textiles was assumed.

Limitations and Assumptions of the Study

When a global perspective is sought, study of all elements in depth is impossible. Not only is competence development multidimensional, but each dimension is interwoven with each other dimension, giving an

infinite number of bonds to consider. As a beginning, it is hoped that the models will stimulate empirical research within the conceptual framework of the models.

Several assumptions are held concerning the use and purpose of the models developed.

1. It is assumed that the learner can be conceptualized as a system. As a system, the learner is influenced by both internal and environmental factors.

2. It is assumed that interaction exists among components of the learner's environment.

3. It is assumed that a holistic model for viewing developing content and process competence is not available.

4. It is assumed that learners develop increasingly complex competence as they proceed through time/space.

5. It is assumed that the rapidly changing needs and goals of the learner and a rapidly changing society which influences those goals may be viewed from the unified perspective of an ecosystem model. Seeing a holistic picture will enable learning facilitators in intervening in a learner's competence development process.

CHAPTER II

REVIEW OF THE LITERATURE

A review of the literature concerning competence development in education revealed inconsistencies in the interpretation and thrust of the concept. It is possible to assemble a continuum of interpretations ranging from a static concept to one where competence is relative, changing, and dynamic. Interpretations are based on different theories of learning and instruction; an assessment of the concept will involve the varied perspectives. Following a review of competency-based education, component educational modes included in competency-based formats will be considered independently.

Definitions and Interpretations of Competence Development

Varied viewpoints are shown subtly in the inconsistent titles given to the concept. Competency-based teacher education (CBTE) is a typical title because a predominance of effort in competency-based formats has been placed in this area. Competency-based instruction, competency-based learning, and competency-based education are widely used terms. Competency-based education (CBE) is used in this paper for consistency and for providing a broad context for the analysis. The varied titles are used when referring to the work of authors who seem to prefer or defend the variations.

Competency-based education was defined by Schmieder (1974) in his glossary of terms as a "system of education which places high emphasis on the specification, learning, and demonstration of those

competencies which are of central importance to the effective practicing of a given profession or career" (p. 7). In the context of higher education, Meeth (1974) described competency-based education as the "minimum knowledge, skills, values and/or attitudes a person can be certified to possess based on a set of criteria or level of expectation" (p. 6). Knott (1975), speaking in a somewhat more process-oriented context, described competence as "having requisite abilities or qualities" (p. 28). Kidd and Natalicio (1973) said that "competency-based learning is simply a summary label applied to the on-going sequence of particular interactions which have been systematically designed to approach and finally to approximate the particular performance standards" (p. 31). They based their interpretation on competence as defined by White (1959)--"the organism's capacity to interact effectively with its environment" (p. 297)--a definition not given in light of CBE. In education, according to Kidd and Natalicio (1973), "competence serves the process; the process is not subservient to the notion of competency" (p. 34). They saw competence as the corrective feedback loop to subprocesses of the system.

Noddings (1974b) dealt with CBE in assessing the Kerr-Soltis (1974) descriptive action model of competency-based teacher education, but her own meaning of competence involves "mental organization underlying a particular set of behaviors" (p. 356). Such a view allows Piaget's stages of intellectual development (sensorimotor, preoperational, concrete operational, and formal operational) to be considered a competence theory, as Piaget's stages are also considered a theory of learning (Lefrancois, 1972). Competence development includes not only

change in performance but also development of complex cognitive structures.

Howsam and Houston (1972) listed essential components of competency-based education:

> 1. Specification of learning objectives defined in behavioral terms;
> 2. Specification of the means for determining whether performance meets indicated criterion levels;
> 3. Provision for one or more modes of instruction pertinent to objectives, through which the learning activities may take place;
> 4. Public sharing of objectives, criteria, means of assessment and alternative activities;
> 5. Assessment of learning experience in terms of competency criteria;
> 6. Placement on the learner of the accountability for meeting the criteria. (p. 5)

Common components but not necessarily distinguishing characteristics, according to these educators, include: (a) guidance and management support, (b) criterion-referenced testing, (c) use of technology, (d) systems approach, and (e) modular packaging. Howsam and Houston emphasized the coinage of "competency-based" as a term differing in meaning from "competence." They saw "competency-based" as depending on an ability to do rather than an ability to demonstrate knowledge. "Competency-based" differs from "competence" in assumptions and approaches, not goals (Howsam and Houston, 1972). The term "competency" is unique to the CBE movement.

CBE models representing competence development are based typically on a cybernetic structure. Representatives of the American Home Economics Association devised the model in Figure 2. Similar to this perception is the model developed by the Department of Vocational and Applied Arts Education at Wayne State University (1972) (see Figure 3).

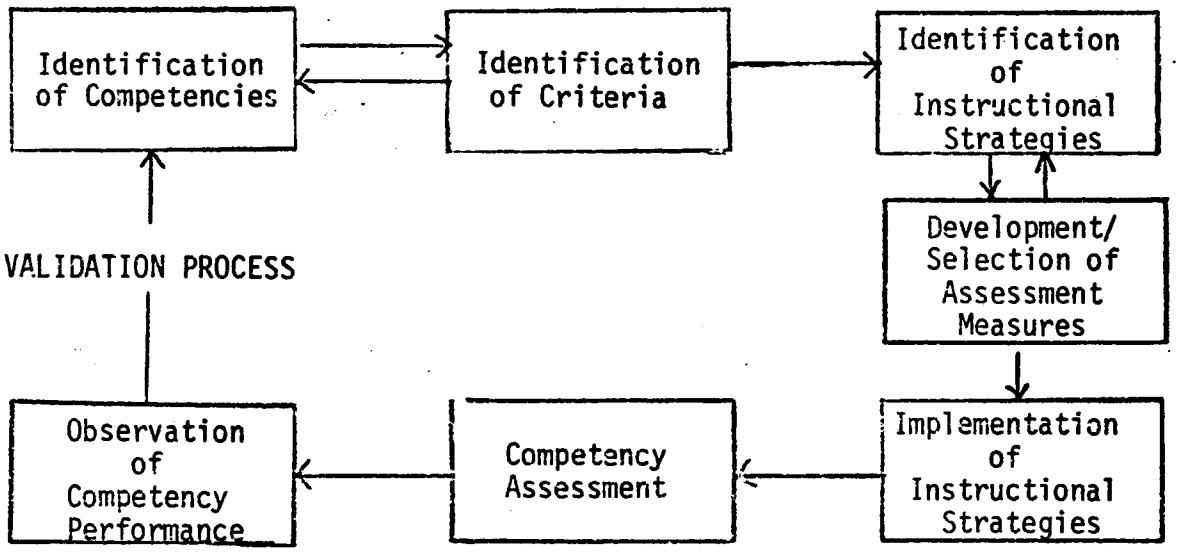


Figure 2. Model for implementing competency-based professional education in home economics ("Competency Based Profession," 1974, pp. 6-7).

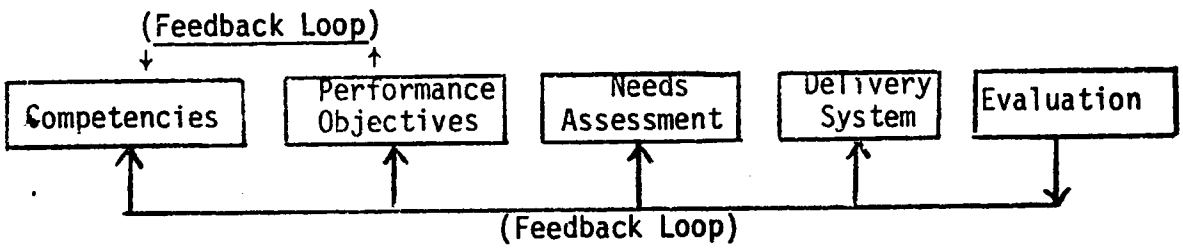


Figure 3. A competency-based instructional system.

Philosophical and Theoretical Bases for Competence Development

H. Johnson (1975) noted the social and political derivation of CBE. He emphasized the lack of a theoretical base. Klingstedt (1973), on the other hand, suggested a theoretical base in behaviorism, where the emphasis lies in changing an individual's behavior. CBE components such as behavioral objectives imply this theoretical source. Klingstedt offered a philosophical interpretation more congruent with a process-structuralist model. Here, an absolute answer is not prescribed. The goal of competence in this setting is effective interaction with the environment as each is perceived by the individual. Klingstedt explained (in agreement with Bruner) that rather than seeking answers, one should acquire strategies, skills, and techniques for the unique purposes of the learner. Competence as effective interaction with one's environment is an on-going goal of the learner.

Klingstedt (1973) emphasized the appropriateness of flexibility in interpretation of CBE as educational philosophy varies. He included White's previously mentioned concept of competence as effective interaction with one's environment as a viable way to interpret competence development. White's and/or Noddings' competence development frameworks can be used as theoretical bases for expanding on the typically behavioristic interpretations of CBE. It is with the critical and advocacy positions in mind that a competence development model has been designed within this paper.

The development and interpretation of the concept of competence as it appears in psychological literature may be attributed to Robert W. White (1959). Though not developed in an educational context, White's

idea of competence is appropriate in assessing competence as a result of person-environment interaction. White (1959) suggested that behavior has an exploratory character which leads the organism to discover how the environment can be changed and what will result from the change. White took issue with the idea that a person's behavior results from the action of environmental influences. Rather, he took the position that people can affect their own developments by taking the initiative in interaction with their environment. Competence involves both confidence and skill for successful interaction with one's environment.

Piaget (cited in Thomson, 1964) explained development as a function of person-environment interaction. He proposed that through interaction with environment, a person is able to progress from simple to more complex levels of development. Adaptation, according to Piaget, is a balance between assimilation and accommodation and tends toward equilibrium. Assimilation requires that substances from the environment are taken in, then changed by the organism in order for the organism to adapt. Behaviorally, the organism acts on the environment, rather than remaining passive. Accommodation can be explained as the action of the environment on the organism. The organism is changed by the action of the environment on it (Thomson, 1964). Adaptation is on-going. It increases in complexity as the organism develops.

The dynamics of person-environment interaction may be viewed appropriately in a framework based on ecosystem theory. Ecosystem concepts provide a basis for envisioning the types of development resulting from organism-environment interaction. An ecosystem framework provides a basis for considering reciprocal organism and environment influences.

Nardine (1971) took White's concept of competence and interpreted it in an educational perspective. Nardine included two dimensions--knowledge and confidence--dimensions for exploring new situations, new areas of learning, and skill development. (He defined confidence as an ability to cope--the individual's sense of being competent.) Growth requires that both be present. Nardine emphasized the advantage of early development of confidence, which facilitates competence development. Competence develops with continuous person-environment interaction. Success in competence development will be determined in part by the way in which challenges are met during critical stages in development of competence. Two critical stages occur approximately at age 2 years and age 6 years (Nardine, 1971). The degree of competence achieved during these times will contribute to successes in competence development in later life (Nardine, 1971).

Nardine (1971) stated that competence grows out of the continuing process of testing the environment and observing the results one produces. People begin to view themselves in terms of their perceived successes in dealing with their environments. Hence, competence develops. This thinking is similar to Hunt's (1975) and Kogan's (1971) concern with developmental as well as contemporaneous individual characteristics.

Four states of cognitive competence (performance plus confidence) have been delineated by Nardine (1971) with suggested teaching strategies for dealing with each state. States include:

Group 1: high performance, high confidence
Group 2: high performance, low confidence
Group 3: low performance, high confidence
Group 4: low performance, low confidence

Instructors must be sensitive to each state in order to facilitate further competence development.

The implementation of the Nardine concept of competence requires a variety of opportunities to interact with the environment. Important in understanding competence from this viewpoint is that competence is not an end but a means. The world is changing and so are the answers (Klingstedt, 1973). Competence will vary with individuals and their goals. Each person will possess his/her own set of behaviors--his/her own competence.

Noddings' interpretation of competence as "mental organization" (1974a, p. 356) is consistent with an interpretation of Piaget's description of mental schema characteristics of developmental stages as a competence theory. Noddings' question in developing a competence theory was: How is cognitive structure to be formed?

> At the present time we can say that an emphasis on the transformation of cognitive structure as opposed to, say, the induction of changed responses, will lead us to prescribe activities for students which are much less product-oriented and far more function-oriented than those we usually see in school today. (p. 358)

Such a competence theory is in agreement with theories of human information processing (Schroder, Driver, and Streufert, 1967) studies of conceptual level matching (Hunt, 1975), and the whole thrust of process education where process is of equal or greater importance than content (Dewey, 1944; Schroder, Karlins, and Phares, 1973).

It is clear that Noddings intended no relationship in philosophy between competence theories as she described them and as CBE advocates employ them, because she emphasized the clear philosophical difference

between competence theorists and behaviorists. Competence theorists have typically suggested that process is vital in developing competence. Noddings (1974a) suggested defining learning as a "non-trivial transformation of cognitive structure" (p. 360).

Generally, a goal of competence development has been providing a basic structure in which subject matter can be revealed. Carroll (1974) stated that the "concept of the learning task is defined to include the attainment of that degree of competence which will make transfer essentially as automatic as demonstration of performance in the original setting" (p. 35). With the ability to transfer competence, the learner can make use of the stimuli received from the environment (Klingstedt, 1973).

The interpretations and criticisms of competency-based education are as numerous as for other instructional approaches. At face value, CBE has some or all of the attributes of other instructional approaches which are elective in designing instructional systems. Controversies have loomed in the field of teacher education primarily because the approach has, in some cases, been mandated by legislation. Criticisms have come from subject matter specialists who wish to "reserve the right to choose pedagogical methods and content of instruction" (Sandoz, 1974, p. 304). Others have criticized CBE as a fragmented or lowest common-denominator approach to education which emphasizes only facts and content. Given the behaviorist base of CBE, many criticisms are similar to those raised about behavioral objectives. Menges (1975) stated the skeptical feelings of many professionals, including the United Federation of Teachers, in his insistence that reliable and validated means of

assessment be developed before any full-scale institution of CBE occurs.

Components of CBE From Various Theoretical Perspectives

Competency-based education is somewhat unique in its approach to education as a totality, and, according to the popular axiom, a whole is more than the sum of its parts. However, as we look at the concept of CBE through a review of the literature, the "parts" vary and certainly the interpretation of these CBE components is not uniformly viewed. Views are tempered by educational philosophy, vantage point, and preferred learning theories.

Many of the components of competency-based education have been studied outside the context of this educational mode. Research may be found on individualized instruction, independent study, educational technology, behavioral objectives, learning styles, and system approach in education. The concept of learner-environment interaction has been explored. These studies provided a base for theoretical model development which precedes formulation of hypotheses concerned with implementation of a program for a given subject matter area.

Criticism of CBE has been based on how the components are perceived. Because all authors and educators prescribe a flexible approach to CBE, this review includes a discussion of the commonly accepted components from various theoretical bases and educational philosophies. The review includes selected components of CBE, some of which presuppose the existence of others (e.g., individualization suggests varied teaching/learning strategies). The areas considered are: individualization, criterion-referenced performance and testing,

behavioral objectives, and system approach (discussed in Chapter III). The proposed model is intended to provide a multiple-perspective framework for education. Some version of each of these areas is pertinent to some or all educational perspectives.

Individualization. From a scan of educational literature (both practical and theoretical) or from casual discussions with educators of varying stature, one may assume that a point of agreement about structuring education is the necessity for the individualization of instruction. A slightly closer look at the literature or even a moment's contemplation reveals the tremendous diversity of possible interpretations of the concept of individualization. The focus has commonly been on individual differences, which may be drawn from a lengthy list of possibilities. Educators disagree as to which differences should influence educational strategies. In order to assess the role of individualization in competence development, we must look at the varying interpretations and emphases of the term.

Cronbach (1967) delineated traditional approaches to individualization as adaptation (a) within a predetermined program, (b) by matching goals to the individual, (c) by erasing individual differences, and (d) by altering instructional method. Each approach has numerous applications and has been considered for many years.

Genetic factors have been played against environmental factors, with behaviorists, led by B. F. Skinner, being the strongest proponents of environmental factors. Recently, interactionist theories have allowed

the consideration of interaction between organism and environment. Both developmental and contemporaneous individual differences may be considered, as well as both proximal and distal environmental factors (Sullivan, 1972). Developmental individual differences are differences which can be detected as an organism grows older. Contemporaneous individual differences can be detected among people who are contemporaries as far as age is concerned (Sullivan, 1972). Several approaches to individualization will be discussed.

Programmed instruction. B. F. Skinner's stimulus-response theory is widely known and has been broadly applied. His is the learning theory on which programmed instruction has been based. Viewing the learner as a "black box," Skinner concerned himself with the input into the black box and the consequent output. The black box itself was not considered in the analysis. Reinforcement is a major concept in the stimulus-response view of learning--reinforcement being "any and all stimuli that increase the probability of a response occurring" (Lefrancois, 1972, p. 98). What is reinforcing (positive or negative) to one person is not necessarily reinforcing for another. Content has been learned by this method, but the process aspect of learning is minimally considered in Skinner's learning theory.

Individualization via programmed learning has been conceived as presenting like subject matter to all students and simply varying the pace. (Some programmed learning--especially computer-assisted instruction--does involve branching.) Programmed learning presupposes that all students can learn an assigned subject matter, if each is

allowed to proceed at an individualized pace. Content is divided up into sequential segments, and the student is informed of an instructor's goals in terms of behavioral objectives. Some plans allow student participation in selecting behavioral objectives. The Keller Plan and various versions of Personalized Systems of Instruction (PSI) are based on this concept of individualization.

Closely related to and based on B. F. Skinner's learning theory is the Keller Plan. Keller (1968) stated that his instructional method was an attempt at making it easier to master a skill. He further insisted that the method goes beyond training; however, student-teacher and student-student interchange (i.e., process factors) are secondary to skill or content factors. The Keller Plan is only one of several approaches to PSI. Educational technology is assumed in programming learning by this approach. Provision of audio-visual materials allows flexibility in student and faculty schedules. Theoretically, the instructor can spend more time with individual students and with program development when mundane aspects of instruction are provided technologically. And, the student can work at individually convenient times and pace.

A typical criticism of Individually Prescribed Instruction (a version of individualization similar to PSI) was precisely stated in Silberman's Crisis in the Classroom (1970) as follows: "IPI is not individualization as we usually understand the term, but rather what an industrial engineer might call mass production to narrow specification with rigid quality control" (p. 198). This criticism was spoken in particular as rebuttal to IPI advocacy exhibited and reported by Glaser

and his associates in their highly publicized Learning Research and Development Center, Pittsburgh.

Mastery learning. Bloom (1974) has expanded the PSI thinking somewhat by suggesting that the approach as well as the pace be individualized. Mastery learning began with the ideas of Bloom and his colleagues and is a major component in most competency-based education programs. Bloom (1974) based his approach to mastery learning theory on the idea that "if students are normally distributed with respect to aptitude but the kind and quality of instruction and learning time allowed are made appropriate to the characteristics and needs of each learner, the majority of students will achieve mastery" (p. 4). Formative (as opposed to summative) evaluation acts as a feedback device for assessing student status and progress during learning. Diagnostic-progress feedback testing (formative evaluation) is a responsibility of both teacher and student.

Bloom (1974) reported a tendency toward cooperative rather than competitive learning along with a more positive self-concept with the mastery approach to learning. Difficulties of mastery learning cited include: (a) failure of students to assume responsibility for correcting learning difficulties revealed in formative tests (tests given at intervals during a given learning setting), (b) continuation of failure in a history of poor academic work, and (c) difficulty in sustaining new teaching-learning strategies over time (p. 8).

Similar assumptions among programmed learning, PSI, and Bloom's mastery approach include: (Block, 1974, p. 21)

1. All can and will learn.
2. Level and content of mastery are defined.
3. Learning is broken into small units which are sequenced.
4. Mastery is insured with a feedback/correction component.
5. Mastery of one unit is required before going to the next.
6. Grading is done on an absolute basis.

The grade used by Bloom in his study was based on a term exam of the whole course. Keller based student grades on performance on each unit. Consequently, Bloom expected the student to synthesize the unit information into a total context. Each method assumed a linear structure to education--an additive change.

Diversified learning opportunities. Studies which have involved the manipulation of single variables in the learning environment have revealed mixed results. Born, Gledhill, and Davis (1972) reported that personalizing instruction had the greatest impact on the academically average and "poor" students. In a study implemented in an undergraduate textiles course, Maclin (1974) found that making proctor grades contingent on final examination grades did not affect student progress through the course or student attitude. Also, in her analysis of the personalized system of instruction, she found that bonus points for units completed the first 2 weeks of the quarter had little influence on student performance on the final examination and did not affect progress or student attitude. Gaffney (1971) researched components of programmed instruction for selected concepts in a college textiles course. She found the group using the programmed instruction scored higher than students in conventional

lecture/laboratory settings and finished in a shorter period of time. Student attitudes were not reported.

Individual student learning styles have been considered by offering more than one instructional mode. Consistency is lacking in reported results. Pascal (1973) allowed students to select among three instructional methods--lecture, lecture with discussion, and independent study. His objective was to identify student variables significantly related to choice of options. He supported the idea that options do appeal to different types of students with different habits, abilities, and experiences. Dalton and Johnson (1975) showed that difference in instructional format was significantly related to the ability of students to perform. The formats were termed "traditional-on-campus" and "off-campus," fitting the concept of university without walls. Davis, Marzocco, and Denny (1970) reported that students allowed to select their own treatment modes did not score higher than students whose treatments were prescribed by the experimenter. They concluded that the effects of individual differences were masked by the statistical mean. T. Harries (1973) also suggested that individual differences be investigated when studying multidimensional variables. (Harries' study dealt with an undergraduate textiles course.)

Baker, Bakshis, and Tolone (1974) diversified learning opportunities in an undergraduate sociology course. They reported a disproportionate number of students electing the traditional lecture system, a tendency which indicated that providing students with a choice simply augmented students' weaknesses. These researchers also suggested that

the procedures could have been approached from a broader perspective. Heslin and Blake (1969) stated that personal commitment was much more evident when students were allowed to select their own goals.

Person-environment interaction. Cronbach (1967) has dealt with individualization in terms of student aptitude. He defined aptitude as a "complex of personal characteristics that accounts for an individual's end state after a particular educational treatment, i.e., that determines what he learns, how much he learns, or how rapidly he learns" (Cronbach, 1967, p. 23). Style of thought and personality variables may be as important in assessing aptitude as test scores. Cronbach theorized that a person's learning rate will vary depending on the nature of the instruction. Hence, he hypothesized that "adapting instructional technique will in the long run be more important than merely altering the duration of exposure" (Cronbach, 1967, p. 26). He was one of the frontrunners in advocating that an aptitude-treatment-interaction (ATI) was a more appropriate way of assessing the process and structure of learning than looking at each component in isolation. Aptitude refers to learner characteristics or individual differences in regard to the problem. Treatment refers to instructional materials or procedures; and interaction is used as in analysis of variance interaction, meaning an unequal, contrasting effect by the treatments on the subgroups of the subjects (Rhetts, 1972).

Hunt (1975) summarized reasons for resistance to the application of ATI. These included:

> (a) hardening of disciplinary categories, (b) the belief that not too many ATI's exist, (c) the idea that understanding individual students does not insure meeting those needs, and (d) the fear that differential effects may lead to stereotyping and inequitable treatment. (p. 210)

Hunt's rebuttal to the criticism that coping with individual differences will only frustrate the already overburdened teacher included the following statement:

> We may know more than we can implement in the future, but this will depend not only on the state of knowledge but also on future systems of educational arrangements. It would seem most reasonable, therefore, to continue to try to gain some understanding of individual students and then to attempt to translate such knowledge into practice. (p. 216)

Rhetts (1972) has insisted that for individualization to be effective, it must result from some form of ATI. If ATI exists, those that are relevant must be recognized.

Gilley and French (1976) presented the outcome of research concerning sensory input processes as components of personal learning styles. Using visual, aural, haptic, interactive, print, and kinesthetic modes of instruction with third-grade students, they discovered that sensory input or manner in which information was acquired affected the students' success in learning. It appeared that a learner's dominant modality developed early in life and was not subject to fundamental change (Sperry, 1972). However, Gilley and French (1976) posed questions concerning whether or not the styles change at different stages of development. Of similar concern was the relationship between the individual's modality preference and actual modality utilization.

Glaser (1973) emphasized, in congruence with Piaget's stage theory, that instructional design should be geared to matching a learner's

cognitive demands. Cognitive competence is acquired and developed from the simple to the complex. A specified degree of competence is necessary before moving to a more complex learning environment. Noddings' competence theory supports this thinking.

Several researchers have been concerned with other intraindividual variability on which to focus individualized instruction, rather than to focus only on age, IQ, or interests. Coop and Sigel (1971) reported on information-processing variables--cognitive style. They used the term as it denotes "consistencies in individual modes of functioning in a variety of behavioral situations" (p. 152). The term is variously referred to as conceptual tempo (Hall and Russell, 1974; Kagan, Moss, and Sigel, 1963), modes of perceptual organization and conceptual categorization (Kogan, 1971; Witkin, Dyk, Faterson, Goodenough, and Karp 1962), and strategies of response (Bruner, Goodnow, and Austin, 1956).

Coop and Sigel (1971) suggested that learning involves existing cognitive skills plus motivation, thereby requiring an interaction between cognitive and affective domains. These authors have hypothesized also that in a younger child, style operates more on an ability factor; whereas, older learners with increased cognitive development may become preferential in their cognitive style.

Robinson and Gray (1974) reported a relationship between cognitive style and performance on school learning tasks. This relationship may be important in assigning a student to a particular instructional treatment. Rhetts (1974) expanded on this idea by recommending three variables for interaction study--task characteristics, learner characteristics, and mode of presentation or instruction (treatment). At the

same time he suggested that the characteristics of the task and its demands on memory, knowledge, motivation, and abilities be analyzed first when setting up an experimental design. Then, individual-difference characteristics related to performance demands of the task should be studied. Rhetts suggested analysis of different treatments or modes of instruction be last. Otherwise, the learner is likely to respond to common stimulus aspects among the tasks, or rely on an overlearned behavior which is generalized to the task.

Several educators and psychologists have concentrated on a person-environment interrelationship in attempting to understand effective learning. Glaser (1972) stated, "Behavior partly creates the environment and the resultant environment influences the behavior" (p. 11). Glaser's ideas are congruent with the person-environment paradigm presented by Hunt (1975). Hunt emphasized the importance of adopting new ways of thinking when a coordination of person characteristics and learner-environment is the focus of instructional design. He concluded that "person-environment analysis is as relevant in prose learning, computer-assisted instruction and behavior modification as it is to the study of differential instructional techniques" (Hunt, 1975, p. 213). Hunt pointed out that the person-environment relationship is not synonymous with ATI, the latter being more limited.

The thrust of Hunt's thinking has been on the reciprocal effects of person and environment. Hunt was equally concerned with accommodating differential behavioral effects and emphasized the importance of a developmental as well as a contemporaneous perspective. Similarly, the $B = f(P,E)$ paradigm designed by Lewin (1936) required identification of

behavior (B) (dependent variable) as a function (f) of the person (P) (kinds of subjects) and the environment (E) (treatment or independent variables). In the classroom the behavior (learning) would be seen as jointly determined by person (kind of student) and the environment (way of teaching) (Hunt, 1975).

Hunt proposed a Conceptual Level Matching Model for testing the Lewinian model. The characteristics Hunt cited for his B-P-E model (Behavior, Person, and Environment) included:

> 1. It should be interactive not only in coordinating person-environment interaction, but in accommodating differential behavioral effects;
> 2. It should view the person in developmental perspective so that the differential effects of environmental influence may be seen developmentally as well as contemporaneously;
> 3. It should consider person-environment interaction in reciprocal terms that view the effect of the person on the environment as well as the effect of the environment on the person; and
> 4. It should consider practical implications of such interactions so that the conceptions can be enriched by application. (Hunt, 1975, p. 218)

Tomlinson and Hunt (1971) reported that low-conceptual-level students learned better with rule-example order (high structure) than with low structure environment. High-conceptual-level students performed fairly well in all conditions. McLachlan and Hunt (1973) showed that low-conceptual-level students performed better with the lecture method than with the discovery method. High-conceptual-level students showed no difference. The researchers were left with the question of whether one determines what a student needs "by objective analysis or by the student's statement of preference" (p. 159). Glaser (1973) proposed that children who are left alone are "good at finding the right match

of materials for their own abilities and learning styles" (p. 561). He did not discuss the appropriateness for growth of these children's choices. An exploratory mode or "browsing model" was suggested based on a statement of specified objectives. Glaser advocated a total learning environment designed to facilitate learning objectives.

McInnis (1969) advocated an "acquisition model" for educational process. In this model, the student discovers and uses information which can be related most meaningfully to particular student needs. The student is the source of initiative in this model.

Verzaro (1975) proposed multiple-model programming as a means of recognizing uniquenesses among children and teachers. The concept of multiple-model programming involves the identification of student needs, teacher personality and teaching philosophy, and program goals. These variables are matched in an attempt to provide the combination which will provide the best educational experience for the learner. Cunningham (1975) criticized multiple-model programming for not providing environmental diversity for the learner. She proposed the integration of several learning subsystems, based on general system theory, thus, providing a context for the learner to develop diverse coping skills for effective involvement in a complex society.

Cognitive complexity has been advanced by Harvey, Hunt, and Schroder (1961) as an information-processing theory. They conceptualized a continuum of complexity from concrete to abstract. Relative integrative complexity is sometimes used to convey the same idea. Schroder, Driver, and Streufert (1967) concentrated on the coping capacity of

persons of varying levels of integrative complexity when subjected to variations in environmental information complexity. Their theory was originally a theory of personality development. Hunt began his work with Schroder, Driver, and Streufert in conceiving conceptual level as a personality characteristic. This characteristic may be subdivided into cognitive complexity and interpersonal maturity. The conceptually complex are more likely to deal successfully with responsibility and adapt to change than are low-conceptual-level learners. This theory was a beginning for much person-environment relation study.

Some of the validation of the theory was presented by the original authors and their colleagues. Streufert and Schroder (1965) used a simulated decision-making environment to test some theoretical ideas that Schroder, Driver, and Streufert (1967) presented in their book, Human Information Processing. They proposed that differentiation and integration in behavior (performance) would increase as the complexity of the environment increased up to an optimal level. An inverted U-curve would illustrate the downward turn in performance as the subject went beyond that optimum point. The shapes of the curves and differences between abstract and concrete processors followed the theory presented.

Karlins and Lamm (1967) tested 60 students with similar intelligence but varying in conceptual level to test Schroder, Driver, and Streufert's theory of structural complexity. They found that integratively complex students were more active in an information search directed toward a complex problem-solving task than were their integratively simple counterparts.

A measure of the effects of changes in information load and complexity of student conceptual structure on information search was explored by Streufert, Suedfeld, and Driver (1965). Generally, as information load increased, information search decreased. Students exhibiting a higher level of conceptual complexity were less affected by increasing information loads than the subjects who were low in conceptual complexity.

Further validation of the Harvey, Hunt, and Schroder information-processing theory was based on Suedfeld and Hagan's (1966) study of the conceptual structure and information pattern as measures of information processing. They proposed that concrete processors would handle information in less complex ways--less integration of responses, minimum use of relevant information, and less discrimination among stimuli--than would abstract processors. Information complexity consisted of depth, breadth, and rate of information change. Considered also were factors such as success and failure, set and orientation, congruence versus incongruence, and previous information. The results indicated that conceptually complex thinkers processed complex information more effectively while using more complex approaches than did less complex processors.

Schroder et al. (1967) were minimally concerned with content but primarily focused on ways people learn to combine or use information for adaptive purposes. A sharp distinction was made between <u>what</u> a person thinks and <u>how</u> that person thinks. In understanding adaptation, two classes or information were considered: (a) Content variables--provide information about the acquisition, direction, and magnitude of responses, attitudes, norms, and needs; and (b) Structural variables--provide a

metric for measuring the way a person combines information perceived from the outside world, as well as internally generated information, for adaptive purposes.

Static structures consist of rigid concrete thought, not having an ability to take more than one perspective. This state may be viewed as characterizing a relatively closed system. Rules of information processing are modified very little within the system. Individuals with emergent rule structures have exploratory and creative tendencies and complex thought. These characteristics reflect many ways of interrelating perspectives and generating new rules for decision making. Amount and speed of information processing varies (Schroder et al., 1967). Schroder et al. illustrated how information-processing levels (conceptual levels) vary between and within individuals under varying conditions such as stress.

Dewey (1944) expressed the importance of considering both learner and environmental factors in facilitating growth in learners. He maintained that purely external direction is impossible. Responses to environmental stimulus proceed from tendencies already possessed by the learner. A great deal of superfluous energy will be expended if the learning environment is not designed with consideration for the developmental status of the learner. He placed a responsibility on instructors to be cognizant of energies in operation by the student so the environment can be deliberately designed to coincide with learner status. Dewey stressed that individual variation be maintained by allowing exploration, experimentation, and application. Such freedom not only allows individual but also societal growth.

The individualization component of competence development has been reviewed from a broad perspective. The merits of each conceptualization must be viewed from the theoretical base underlying each interpretation of individualization. Factors both external and internal to the learner may be considered along with the integration of the two--both person and environmental factors. In viewing the learner as the central focus, the processes which are operational in competence development are of concern.

Models in Chapters IV and V are based on concepts of selected theories. Individualization based on mastery learning provides a basis for considering pacing and mutual understanding between learner and facilitator as to what the goals of the specified learning situation involve. Studies of the differentiation of learning environments exhibited the need for considering environmental structure conducive to learning styles. Learning styles based on how information is received and then used help in understanding how environmental structure is determined. Consideration of cognitive styles further extends the multi-dimensional aspects of competence development. A final consideration is that of interrelationship of person-environmental structure and the processes involved in achieving competence for a specified learner in a unique environment.

To summarize the discussion of individualization for the perspective of the entire education system, Frymier's (1973) comments from A School for Tomorrow are appropriate. Frymier emphasized the importance of individualization of the entire school setting, stressing that this individualization includes consideration of student's academic needs,

social needs, and personal needs. Rather than seeing school as serving the vocational (subject matter) or societal needs, Frymier viewed the school as teaching in the direction of individual needs.

> If one begins with the premise that man is the end, it follows logically that subject matter is the means. This concept . . . presumes that curriculum is a means to an end. There is nothing sacred or even worthwhile about subject matter, except as a means for answering human needs. (Frymier, 1973, p. 16)

This philosophy suggests that the schools conform to individual needs rather than conforming individuals to preconceived school, societal, and vocational needs. Frymier admitted that education is relatively straightforward if initiated from disciplines and social concerns; whereas, if starting with individual concerns, the answers are not so apparent.

Behavioral objectives. An assessment of CBE requires consideration of the merits of behavioral objectives. The competency-based education movement has given an extra thrust to the use of behavioral objectives. Many aspects of CBE and behavioral objectives are based on the same educational theories and philosophy; thus, proponents and opponents of one have similar evaluations of the other. CBE as typically interpreted seems to be an offspring of the behaviorism movement in education--the behavioral objectives movement in particular. Advocates of CBE have supported with few exceptions the inclusion of specific behavioral objectives as essential in a CBE program.

"Objectives are descriptions, in behavioral terms, of what the learner is able to do at the end of any instructional period" (Burns, 1973b, p. 42). Usually, these are terminal behavioral objectives,

expressed from the learner's point of view. Burns emphasized that "closed objectives" (in which the same behavior is expected of each learner) are sometimes, but not always, essential. Advantages cited for behavioral objectives include that they are measurable, thus, providing the "accountability" sought by many present-day legislators and taxpayers. They serve as a record of what is to be learned, as a means of communication between teacher and learner, as a basis for selecting instructional strategies, and as a means for assembling valid evaluation activities (Burns, 1973b).

Hall and Jones (1976) identified behavioral objectives as the separate identifiable individual behaviors which, when interrelated, allow for competence development. These educators perceived competence as a composite performance--one step closer to a learner's goals.

The strong influence of Mager (1962) in promoting instructional (behavioral) objectives is well known. His emphasis has been with identifying terminal behavior--"what will the learner be doing?" (p. 13). His emphasis on behavioral objectives extended to setting a criterion level--"how well do you want the learner to do in achieving the behavioral objectives." In essence, criterion level refers to the accomplishment of behavioral objectives at specified levels or degrees and under specified conditions.

Norman Gronlund (1970), like many other educators, recognized that objectives must be included in several domains of learning. He advocated the taxonomies developed by Bloom (1956) and Krathwohl, Bloom, and Masia (1964) for identifying and defining objectives from the cognitive, affective, and psychomotor domains. Krathwohl et al. recognized that

dealing with interaction among domains was a difficulty with objectives.

Behavioral objectives are delineated before learning commences in order to make these objectives known to the learner and to insure that the instructor has determined what changed behavior is expected. It is relatively easy and systematic to assemble objectives based on subject matter or societal concerns; however, answers are less readily evident when individual student needs are being considered (Frymier, 1973).

Kerr and Soltis (1974) stated that behavior is observable action--activities and skills. H. Johnson (1975) pointed out, however, that "competence" goes beyond performance (behavior)--that it is "inescapably contextual in its definition and, therefore, doubtfully reducible to the neat techniques" typically promoted in CBE (p. 159). Hall and Jones (1976) emphasized the necessity of the individual's synthesizing what is learned in order to be classified as competent. They saw behavioral objectives as a step toward defining competence level. Competence level, then, is the next step after achieving behavioral objectives in progress toward goals.

Messick (1972) considered <u>possible</u> outcomes to be as important an evaluative concern as <u>intended</u> outcomes. In stating the rationale for evaluating side effects as well as intended effects, Dyer (1967) suggested that it may not be possible to delineate the objectives until outcomes are measured. A primary factor in Macdonald's (1973) disenchantment with behavioral objectives existed with the question of values and the fundamental purposes of education. Apple's (1972) criticism represented more specific questioning of the relevance of behavioral objectives. Commenting on their high degree of specificity,

he stated that they tend "to produce a closed loop system which provides little possibility for fundamental change or advancement" (p. 258). And, objectives tend to be culture bound. Too seldom are complex items such as thought processes, attitudes, complex skills, and appreciations considered (Apple, 1972).

Doll (1972) criticized the use of behavioral objectives as separating ends and means. Ends become terminal states rather than "turning points" in a continuous and dynamic process. If ends and means are to interact, according to Doll, they cannot be defined in advance. Macdonald (1965) agreed that objectives are known totally after the learning experience is completed. As an alternative, Doll suggested that goals, activities, and behaviors not be determined <u>for</u> the student but <u>by</u> the student. This approach focuses on the entire process of experiencing--both doing and receiving the results (Doll, 1972). Many proponents of cognitive development theory have seen objectives rising out of the learning situation; thus, the instructor cannot predetermine behavioral objectives. Ebel (1967) posed the question: "Should it (education) not emphasize the cognitive input to decision making rather than the behavioral output?" (p. 263). Ebel has spoken in favor of general guiding objectives which other educators might term goals.

Bruner (1971) wrote that "nowhere is there anything that says that simply because learning takes place in small steps that the <u>environment</u> should be arranged in small steps" (p. 153). He continued that organisms "operate by taking large packets of information and breaking these down into their own bite size and that unless they have the opportunity to do that, learning may become stereotyped" (p. 153).

The value of behavioral objectives seems to be an empirical question (Eisner, 1967). In their review of empirical studies on the topic, Duchastel and Merrill (1973) subdivided behavioral objectives into three categories describing the purposes of the objectives. These were: (a) direction for teaching and curriculum development, (b) guidance in evaluation, and (c) facilitation of learning. Results were inconsistent in all areas. In decision-oriented aspects, behavioral objectives sometimes helped and were almost never harmful. The researchers suggested an investigation of availability of objectives with other variables. They found that dimensions (e.g., behavioral or nonbehavioral) often were not clearly defined--i.e., were without operational definitions.

Criterion-referenced evaluation. CBE factors which are representative of the influence of Bloom's mastery level approach on CBE development is the use of criterion-level performance standards and criterion-referenced testing. Because the mastery of several performance objectives is seen to enable a student to demonstrate competence, competence is the standard criterion level set.

It is important to have a grasp of the concept of criterion-referenced assessment because it is the means for evaluating both the student achievement and the program itself. It is the feedback indicating student progress and program operation (Dodl, 1973).

Mager (1962) was an early promoter of the criterion concept along with behavioral objectives. He insisted that the student be told of performance objectives. He insisted that the student be told of performance expectations. This is accomplished by describing the

criterion level within the stated behavioral objectives. To Mager, this approach gives evidence of the degree of success achieved in meeting program objectives. Howsam and Houston (1972) explained criterion-referenced testing as comparison of learner achievement with stated objectives. Several instructional strategies may be provided in order to help the student repeat attempts to meet the specified criterion levels. This approach is one of the feedback devices employed in typical competence models. If the criterion is not met, the student is "recycled" through the same or another instructional strategy until the standard is achieved. As implied by Hall and Jones' (1976) hierarchy, it is evident that a separate criterion level would be set at the behavioral objective level and the competence level.

Klingstedt (1973) stated that criterion levels are absolute but added that they are not always a priori. Rather, they are "based on experience and their absoluteness is related to a specific time and situation" (p. 12). Criterion levels change as the situation demands.

Coupled with criterion-level assessment is self-pacing, because for many reasons not everyone will or can reach a criterion level or standard criterion at the same pace. Time is a variable. This places criterion-referenced testing in opposition to norm-referenced testing. With the former, the performance of other students is not the issue, but the idea is whether the student achieves the stated objectives. Controversy looms about the merits of <u>all</u> students reaching criterion level (which may be considered as arbitrarily determined). Criterion level might vary from student to student.

The question is raised: For whom and by what means is competence or criterion level determined? Another question involves the degree of acceptable restriction. These are perhaps the most controversial aspects of CBE.

The question of how criterion levels are determined is responded to in several ways. The variation is often set according to the type of learning involved. For example, McClelland (1973), speaking primarily of skill (occupational) development, suggested analyzing performance into components. He expanded this idea by suggesting that tests for competence "should be designed to reflect changes in what the individual has learned" (p. 8). Scores on tests, according to McClelland, change as the person grows. Competence will increase with growth. Teachers and students collaborate to improve performance on mastery tests based on criterion sampling. Finally, clusters of "competencies" should be assembled with the student's goals in mind.

Dodl (1973), speaking from a teacher education base, insisted that a program be reexamined constantly and revised in light of new information and in light of the total system. Constantly, comparisons must be made between competencies attained and competencies expected.

Both personal and generalized concerns must be assessed, thus, adding to the complexity of developing a competence <u>program</u> geared to individualization of <u>student</u> competence development. One suggestion was development of a cumulative profile (Dodl, 1973). The syntehsized performance of an individual student may be quite a unique cluster of individual competencies.

Valeski (1972) took a different orientation to the determination of criterion level--i.e., competence standards. He suggested that determining the credibility of competencies within a professional area may follow either of two approaches: (a) literature descriptions, certification and licensing requirements, and graduate level course contents which reflect the "ideal" skills and proficiencies; and (b) field-based evaluation, or needs-assessment method which provides the potential competencies for consideration.

The latter is similar to the approach suggested by Adams (1974) in his article on "Building Competency Models: One Approach to Occupational Analysis." These ideas correspond more to preparation for a preidentified career than to that for a general education.

Several proponents (Burns, 1973a; Hall and Jones, 1976; Valeski, 1972) of CBE suggested that process as well as content competencies be included. Few mentioned cognitive process development within the learner as a competence to be developed.

A representative critic of criterion referencing or mastery performance standards is Groff (1974). As would be expected, his is a critique of behavioral psychology as well. First, he questioned the hypothesis that all students have aptitude for <u>any</u> specified subject or skill. He questioned the proposed lack of relationship between aptitude and achievement. He based his argument in part on the lack of supporting empirical evidence for mastery performance. If offering alternative approaches to instruction, said Groff, will help a student to achieve mastery, why, then, is the "successful" approach not presented to the student initially? He also predicted that a student will be as sensitive

to slower progress and repeated attempts as to low grades in a norm-referenced testing setting.

A review of the literature about individualization, behavioral objectives, criterion-referenced testing, and the total concept of CBE provide a broad perspective on factors to be considered in multi-dimensional competence development. Reviewing these factors from broadly differing philosophies and with empirical data from learning and content perspectives provide scope and reference necessary for assembling models based on ecosystem theory. An ecosystem theoretical framework for competence development is presented in Chapter III.

CHAPTER III

ECOSYSTEM THEORETICAL FOUNDATION FOR THE DEVELOPMENT OF A COMPETENCE MODEL

One purpose in developing a competence model is to provide means for viewing the totality of competence development. This chapter pertains to the rationale of using an ecosystem theoretical framework for structuring such a model.

Ecosystem theory is one aspect of general system theory in which the area of concern is the interaction of an organism in the context of its environment. Three overriding reasons for selection of an ecosystem framework are:

1. An ecosystem model provides concepts representing states and relationships between any living (open) system and its environment. A learner may be looked upon as a system interacting with its environment.

2. Home economics generally has been accepted as a field of study which is ecological in nature. In many instances ecosystem conceptualizations have been implemented in home economics. Therefore, this field may be used in explaining the workings of the models.

3. Given (1) and (2) above, a unity between content and process may be conceptualized and implemented more easily using one theoretical framework. Such an approach is then applicable to any learner/system.

This chapter begins with selected literature pertaining to system theory usage in education. Consideration will then be given to the implications behind the use of system theory for competence development.

Elaboration upon selected system concepts appropriate to competence development will be included. This background provides the basis for analyzing and interpreting the models which will be presented in Chapters IV and V.

System Theory Usage in Education

For some time, system theory or philosophy has been recognized as a means for analyzing complex problems. It is generally agreed that the educational system is a complex structure and, therefore, presents complex problems. However, when systems analysis is equated with task analysis, education is often treated as a relatively closed system. Apple (1973) saw curriculum specialists as employing systems analysis to manage curriculum problems without first understanding the complexity of the relationships themselves.

Typical system usage in education is limited to system planning techniques. A large-scale example was exhibited in the system model developed by a consortium of 10 institutions in the United States for constructing teacher education programs. The project was undertaken with the sponsorship of the United States Office of Education. Broad system planning principles were followed by each institution with accomplishments reflecting individual program considerations (Joyce, 1972). Such an endeavor illustrates the broad application possible, given a common framework.

In an analysis of the teacher education models resulting from the work of these institutions, Apple (1972) suggested that system design was used conservatively and as quality control. Such an approach emphasized

external control and regulation; a static view of the example implied a relatively closed system. In contrast, the Syracuse University teacher education model emphasized the necessity of maintaining an open system when dealing with the constant self-renewal which education theoretically represents.

Howsam and Houston (1972) summarized the general attention given to the use of a system approach in competency-based education:

> The systems approach is designed to deal with complex realities. It has been employed in the development of both the delivery systems for learning opportunities and the management systems for records and accountability. The concept of feedback loops is particularly useful in designing instructional modules. The graphic device of flowcharting has proven invaluable in presenting the options available in an individualized instructional system. Like technology, however, the systems approach is but another enabler for competency-based instruction. (p. 5)

A typical system model, on the order of that described above, was developed at Wayne State University for the implementation of a competency-based program and appears in Figure 3, Chapter II, page 13.

Bertalanffy (1968a) is often quoted with his definition of a system as "the totality of elements in interaction with each other" (p. 38). Laszlo (1972) explained use of system theory as "looking at the world in terms of . . . sets of integrated relations. It is the present and next choice over atomism, mechanism and uncoordinated specialization" (p. 19). A system can be further described according to suprasystem (including components of the system surroundings), a system (identified body of concern), and subsystem (those components into which a system may be subdivided). Education has used four forms of system theory:

1. General system theory has been considered appropriate for looking at education because of its assumptions of nonlinearity and complex interaction of parts. Many theories assume linearity and additive combinations. General system theory allows characterization of a system as a whole; whereas, many educational theories look at one specified unit at a time (G. Maccia, 1963).

2. Cybernetics offers a means for assessing feedback and its effect on the state of the system, system monitoring, and system adaptation in light of information. Cybernetics is a movement within the general body of system thought which maintains that study of messages and communications can facilitate the understanding of humans and society (Immegart and Pilecki, 1973).

3. Information theory is an outgrowth of cybernetics. It has been used in information systems from machines to organizations. An information theorist is interested in the energy potential of messages (Immegart and Pilecki, 1973). Input and output can be described according to their information content (G. A. Miller, 1956).

4. Several educational models may be seen as based on ecosystem theory because ecosystem is a "name for the interaction systems comprising living things together with their nonliving habitat" (Evans, 1956, p. 1,127). An ecosystem is an open, living system.

G. Maccia (1963) identified the school as a system. Macdonald (1971) saw teaching as four interacting systems: curriculum, instruction, teaching, and learning. The cybernetic model represented in Figure 4 is useful in education because the context can change according to the system of interest.

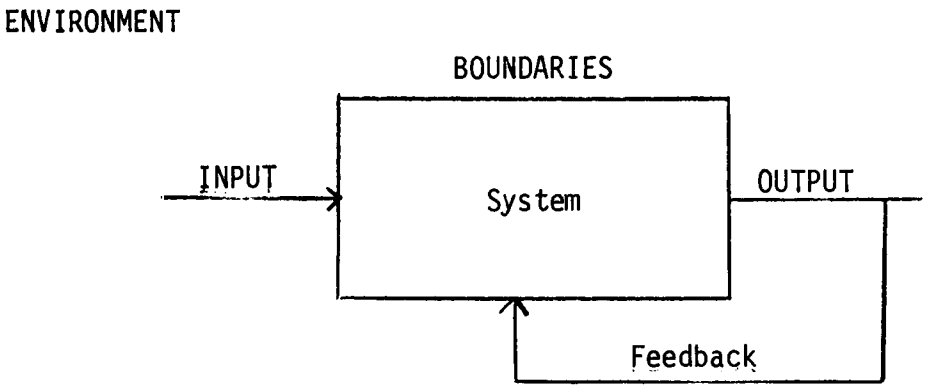


Figure 4. Basic Cybernetic Model.

Numerous educators have studied the relevance of using concepts from the specific approaches to system theory--e.g., cybernetics and information theory--in understanding the teaching-learning process. Feedback, information, coupling, and entropy were concepts considered significant by Packer and Packer (1974). Ryans (1965) recognized the school as an open system and considered feedback and information as essential concepts in understanding instruction via information system theory. Macdonald (1971) used a flexible system approach, incorporating the concepts of general system theory to analysis of the teacher as a system. Boundaries and system hierarchies were used in an effort to define teaching.

E. Maccia (1963) presented the rationale for information theory as educational theory with a focus on problem solving. The development of information theory has been within the context of communication

theory, thus, suggesting its relevance as a basis for educational theory. For example, "communication is seen as a flow of some information-carrying commodity in some network. Ordinarily language, too, is an information-carrying commodity. Interpersonal relationships, too, are networks" (E. Maccia, 1963, p. 304). The communication system consists of three parts: a source, a destination, and a channel which connects the two. In problem solving the problem would be the source; the problem as solved, the destination; and the problem solver within a defined environment, the channel (E. Maccia, 1963). This communication system could be termed an ecosystem (organism and environment).

Weiner's explanation of feedback, where control of a system is based on actual performance rather than expected performance, was seen by Packer and Packer (1974) to be analagous to learners' needs for information about behavior as a part of information on which they continue to act. Such an idea supports instructional theories which oppose marking, grading, and testing as feedback mechanisms. Rather, this feedback principle reveals information needed for improved performance (Packer and Packer, 1974). It is more explicit than the principle of immediate knowledge of results.

Ryans (1965) included the concepts of negative and positive feedback in his conceptualization of instruction based on information system theory. He explained how negative feedback permits the system to maintain a state of equilibrium by correcting itself. A teacher will make adjustments in behavior as cues are received from student behavior. The teacher is adapting to the environment. Ryans also cited the relevance of positive feedback in explaining cumulative modifiability of the system,

as in organism growth or in learning, where change in the system takes place as a result of feedback. Information flow is the exchange.

Packer and Packer (1974) noted the analogy between the term "bit" as a measure of information in digital computers and in information theory. "Bits" of information in the learning process may be used in reducing uncertainty. Statements convey information only when they reduce uncertainties. The information is not contained in the statement if uncertainty is not reduced. Each individual receives a different amount of information. Student mistakes may be seen as information on which teachers base instruction.

Important in using system theory for looking at competence development is recognition of the influence of proximal systems in the learner's environment. Packer and Packer (1974) saw coupling as an essential system concept in viewing the learner as a system because reciprocal communication with teachers and other learners is a given with most educational systems. In fact, the combination forms another system. A teacher who examines the total system involving teacher-student coupling will observe different relationships from those observed by the instructor who examines the students as independent noncoupled systems (Packer and Packer, 1974).

Entropy represents randomness and disorganization. Packer and Packer (1974) related this tendency toward disorganization to action in a classroom, whereby perpetuating culture may tend to increase entropy when change is resisted. Equally possible, according to this theory, is that, as centers for organization and differentiation, schools have the potential for decreasing entropy. Stability and change, as exhibited by

culture and education, have been acknowledged by many educators. A balance between negative and positive feedback would seem to stimulate a balance between death and chaos in the educational system.

Messick (1972) stated that multiple influences on behavior should be considered both at the level of system analysis and at the subsystem level. A multivariate framework allows for inclusion of various factors such as cognitive styles and affective reactions along with environmental factors.

An argument for implementing ecosystem theory in a competence model was stated by Frymier (1973): "Changing parts is not enough; the 'whole' must be changed" (p. vii). Frymier, Wilhour, and Rasp (1973) described human behavior as a function of the interaction of the individual and environment. This idea has the same basis as Lewin's (1936) $B = f(P,E)$ paradigm--behavior is a function of the person in an environment. Similar also are Hunt's (1975) B-P-E (behavior-person-environment) model and Cronbach's ATI (aptitude-treatment-interaction) framework. Schroder, Driver, and Streufert (1967) have similarly been concerned with consideration of the relationship between human and environmental factors.

Definitions of System Concepts and Their Application to Competence Development

The system concepts delineated include those which provide for the analysis of the learner as an open system--a complex adaptive system. Basically, the focus is on general system terminology which is applicable to a complex adaptive system as opposed to a system which is mechanistic,

equilibrium seeking, and relatively closed. The learner will be referred to as learner/system. This term will provide a perspective for viewing the learner as a system, while erasing the mechanistic and vague connotation of system. As a living system, a learner/system can be discussed as a human being.

System and ecosystem. A system may be seen as a set of units with relationships which tie them together (Hall and Fagan, 1968). In an ecosystem framework, the system of concern includes an organism which is in interaction with its environment. A designated organism's environment is any set of objects for which a change in their attributes affects the organism and vice versa (Hall and Fagan, 1968). Educators with varying perspectives may identify the organism and environment according to their interest. The learner may be the system of interest for one observer, and another may focus on a classroom of students as the system. In understanding competence development, it is imperative that the concept be placed in varying perspectives. The suprasystem is the next higher system in which the designated system is a component. As a component, the system becomes a subsystem. A subsystem is a set of components which make up the system (J. G. Miller, 1965a). System identification is relative, depending on the orientation of the observer.

Boundaries. Boundaries are more or less arbitrary designations of what a system includes and excludes. The boundary is a universal system property (Immegart and Pilecki, 1973). Boundaries of learner/systems have two basic characteristics: (a) Their delineation is flexible. They can be adjusted through competence development. (b) Their

permeability can be affected, thus, affecting adaptation and growth. At the same time, each of these factors concerning boundaries can influence the other--i.e., the definition or location of a boundary can affect the permeability and vice versa. The boundary of a learner/system may be perceived differently by the learner and by relevant others. The variance may increase as the distance between the system and the perceiver increases.

Boundaries may be set arbitrarily. Unique system components are the determinants. The implications for precise learner/system boundaries are numerous. If like components are considered for all learner/systems, or boundary definition is the same for all learner/systems, the organization of curriculum and instruction is relatively easy. With like boundaries (inclusion of like components), similar expectations may be designated for all. For example, all learner's in one school system may be seen as having similar boundaries so are treated similarly. However, individual learners have unique boundaries which influence their own perspective. People working within a school will view each learner/system differently. Useful boundaries may be agreed upon in order to make the school system perform more efficiently.

Limitations of precise boundary demarcation may be noted. Variation exists in permeability of otherwise similar boundaries. If the same set of factors were used to define two learner/systems, the degree of openness to input/output--exchange of information with the environment--would temper the success of categorizing students according to like components.

Extension of boundaries to encompass growth should be an important goal in developing interdisciplinarity, which is the extension of boundaries to include relationships among disciplines. Identification of boundaries must include consideration for the wide variety of learning sources.

Openness and closedness of systems. An open system exchanges materials, energies, or information with its environment. Given appropriate conditions, an open system will attain a steady state in which its composition remains constant. The constancy is maintained in a continuous exchange and flow of component materials (Bertalanffy, 1968b). An open system model is particularly applicable to analyzing the process of learning because the learning process exhibits "non-structural, dynamic interaction of processes, such as those of metabolism, growth, metabolic aspects of excitation, etc." (Bertalanffy, 1968b, p. 18). And, such systems can maintain themselves at high levels, and even evolve toward increased order and complexity--as is one of the most important characteristics of life processes (Bertalanffy, 1968b).

A goal in developing the model illustrated in this paper is to illustrate competence development as an increasingly complex and ordered process. Adaptation and self-direction toward change are characteristic of an open system. Internal adjustment and near-environmental adjustments are two determinants of individual learning. Interchanges among components may result in significant changes in the nature of the components themselves with important consequences for the system as a whole (Buckley, 1968).

A closed system has no exchange of components with its environment. The openness of a system is relative rather than absolute, and a relatively open system can become relatively closed as energy input from the environment is cut off. A system is closed if there is no import of energies in any form (such as information, heat, physical materials) and, therefore, no exchange of components. Education can be characterized as relatively open or closed depending on the perceptions of each of the individuals involved. The course of the closed system is toward entropy (Bertalanffy, 1968b).

A relatively closed learner/system is likely to result if the learning environment is set up with emphasis on the end, the result, or the consummation of the activity. Openness is more likely if a given learning experience is seen as a stimulus or starting point or a building block toward greater knowledge or understanding. Dewey (1971) cited examples which may be interpreted as promoting relatively closed learner/systems. He explained that pupils taught to memorize learn one-track verbal associations instead of developing varied and flexible connections which compel the learner to look ahead or foresee, thus, setting up new questions and suggesting new understandings.

When external learner control dominates, thus, minimizing exchange of energy with the environment, a relatively closed learner/system may result. A learner subjected to materials or methods which are too easy or difficult is likely to cut off active exchange of information with the environment. Consideration of individual differences is essential in minimizing the occurrences of these closed-system tendencies.

Structure and process. Structure is the way system components are arranged in time/space. Change in system structure is process. Process includes on-going functions of systems (Miller, 1965a). Learner/system structure may be perceived differently by the learner/system and observers. Competence development involves the processes of changing learner structure. Structure may be periodically recorded as a means of evaluation for directing process toward continued change. This type of assessment may be called a student profile.

Matter-energy, information, and entropy. Information, according to Weiner (1967), is a name for the content of what is exchanged with the environment as we adjust to it and make our adjustments felt upon it. The process of receiving and using information is the process of adjusting to the contingencies of the outer environment and living effectively within that environment. Kuhn (1974) defined information as the pattern of matter-energy. Matter is anything which has mass and occupies space, and energy is the ability to do work. One can be converted to the other so the joint term is often used (J. G. Miller, 1965a).

Entropy is the inverse of information. It is the measure of disorganization (Weiner, 1967). Entropy, being perceived as disorganization in structure and process, may characterize the system if the learner perceives irrelevance--waste of time in what is expected in terms of content and learning environment. On the other hand, information represents organization in matter-energy and, therefore, in structure and process as perceived by the learner/system.

It is possible to interpret the information carried by a message as essentially the negative of its entropy. Negentropy refers to increasing order, decreasing chaos, and creativity (Kuhn, 1974). Weiner stated that living effectively is living with adequate information (1967). A student who is continually developing competence in a learning situation (method and content) is receiving adequate information. A steady state is being maintained.

The success of competence development may be described in terms of information. However, if the restrictive boundaries of education suggested by some critics do in fact exist, information may lack the quantity and quality (relevance) perceived by the learner/system as necessary and, thus, lead to entropy. Relatively closed systems are more likely to be entropic. Relatively open systems tend to process more information.

Information is the opposite of uncertainty. It might be thought that information is what formal education is all about. Educators are concerned with the organization of the system--the state of the learner. Piaget (cited in Ginsberg and Opper, 1969) has theorized that development is a process of forming schema. Schema is an organized pattern of behavior involving increasingly complex forms of organization. This idea is in keeping with the increasing complexity of information processed by open learner/systems. Piaget's theory holds that interest and learning are facilitated if the learner recognizes some relevance in the experience while seeing some novel, incongruous aspects. In ecosystem theory this would be looked upon as dealing with positive feedback.

Piaget's concept of developing mental structure involves change in behavior due to accommodation of environmental demands. This development accrues from activities already learned (assimilation) (cited in Lefrancois, 1972). Development of competence, then, involves formation of schema leading to more complex mental structure. This analysis is congruent with the idea that learner/systems are constantly taking in and putting out information, the result being a change in all parts of the system during the process.

It is a responsibility of educators to set an environment which is not so static or chaotic as to surpass the adaptive characteristics of the learner/system. The complexity of the organism and its environment make it difficult to determine which environment is most conducive to the individual learner. The learner needs reliable information from the environment in order to maintain the system's steady state. With drastic changes the learner can take steps to adapt--up to a point. Some negative examples of adaptation, which CBE has sought to alleviate are cramming, cheating, and dropping out. With goals, advance warning, and/or preparation, the learner can select more positive means of adaptation--studying, discussing, reading, and contributing to society.

Steady state, homeostasis, and equifinality. Steady state is characteristic of an open system. It is a dynamic ratio--an existence that seeks increasing order and complexity rather than tendencies toward randomness (Immegart and Pilecki, 1973).

Homeostasis is a condition in which a system maintains a steady state with one or more system variables (Kuhn, 1974). Equifinality is a

property exhibited by open systems. These systems have the capacity to reach identical goals from different conditions or by employing different processes (Immegart and Pilecki, 1973).

An open system is maintained by a constantly renewed steady state, or balance between the system and its environment, through continuous exchange of matter-energy and information with the environment. A learner/system will maintain a steady state, subtly changing through system adaptation to environmental impingements.

The concept of homeostasis is appropriate for understanding learner/system internal change which is directed by environmental forces. However, the open learner/system is capable of elaborating new structures and taking on new functions (Emery and Trist, 1971). Such change is stimulated by acting on the environment. The nature of learner/system action on the environment varies and characterizes the concept of equifinality. Dewey (1944) emphasized the principle that life is a self-renewing process through action on the environment.

Adaptation and self-direction toward change are explained by equifinality in open systems which contain feedback loops for making this possible. Nearly all educational theories support the consideration of the uniqueness of each learner. One of the fundamental ideas of competence development is individualization. Internal adaptation and near-environmental adjustments are two determinants of individual learning.

Criterion-referenced tests contain certain homeostatic devices. The student is expected to review and redo the assignment until an established criterion level is achieved. This is an example of employing homeostatic control (Immegart and Pilecki, 1973). Many educators have

observed equilibrial tendency in emphasizing homeostatic devices. When change or individuality is recognized as important for the learner/system's potential for growth, the potential of equifinality must be recognized. The processing of input varies; component subsystems function differently.

A teaching method generalized to a group of students may result in misused energy with a consequent lack of learner/system growth. It seems relevant in the evaluative procedures of the school to assess a student's means of achieving a steady state and the student's degree of dependence on the identified means with a goal of efficient use of student potential.

An opposite principle to equifinality is multifinality. Multifinality means that similar initial conditions may lead to differing end-states (Buckley, 1967). Often, students with seemingly similar backgrounds and characteristics reach very different ends. Educators have been aware of this occurrence. Learner/system changes and environmental differences influence the nature of learner competence, regardless of initial similarities among learner/systems.

Positive and negative feedback. Feedback is an important concept in system study and helps in an analysis of competence development. Study of feedback control comes under the realm of cybernetics. It is the function of feedback mechanisms to control the tendency toward disorganization (entropy). Feedback is the property whereby a portion of output or behavior is fed back to the system as input to affect succeeding outputs. The nature and degree of feedback in a system have

a decisive effect on the relative stability of the system (Hall and Fagan, 1968). Negative feedback is opposite, corrective, or compensating (Kuhn, 1974). Negative feedback reduces the amount of information input, thus, leading to greater system stability. Signals from the system are used to restrict output which would otherwise go beyond the goal (Rosenblueth, Weiner, and Bigelow, 1968). Positive feedback adds to the input signals rather than correcting them. Growth is a function of positive feedback (Rosenblueth et al., 1968).

Excessive negative feedback is of crucial concern in the current educational situation. Many classroom environments provide environments supportive of students who function as relatively closed systems. Extreme stability derived from a dominance of negative over positive feedback minimizes learner/system growth. A linear approach to education allows for little positive feedback. Teachers with oversized classes seek negative feedback in order to maintain their own steady states. Oversized classes provide enough sources of positive feedback without the added disturbance of consideration of individual learner/system steady states. On the other hand, too much "innovation" without an appropriate mix of stability (derived from negative feedback) or accepted justification has the potential of creating chaos in the learner/system.

Feedback is an evaluative mechanism directly related to competence development. Feedback provides a basis for assessment of competence or designation of certain aspirations. After meeting an assigned criterion level, the student is directed to proceed to the next unit, an example of negative feedback. No deviation in input or output is sought or encouraged. This way, a steady state of a homeostatic nature is

maintained. Information from the system environment causes relatively automatic adjustment. If the competence assessment reveals information which stimulates change or an innovative approach to a problem, the feedback is relatively positive. Growth, creativity, and change are encouraged when competence is assessed this way.

It is important to recognize that feedback may be external, from the system to the environment and back, or it may be completely internal, among the components or subsystems (J. G. Miller, 1965b). Assessment of external feedback in a learner/system is decidedly easier than assessment of wholly internal feedback channels. Consideration of individualization of instruction receives extra impetus when emphasis is placed on the varied sources of feedback.

Meaning and degrees of freedom. Meaning is the significance of information to the system which processes it (J. G. Miller, 1965a). Meaning results from previous experience with the environment. A learner/system's selectivity of information may be determined by meaning. Meaning is relevant in understanding competence development because of the selectivity in choice of competence sought from learner/system to learner/system. Understanding the significance of information to the learner/system can help in directing competence development.

Degrees of freedom are the range of possibilities made available by components of a system. The degrees of freedom perceived by learner/systems will influence their activity (Ashby, 1968). Degrees of freedom to choose among symbols, messages, and signals are another aspect of information. A learner/system perceives options in which to become

involved. A learner/system not perceiving all options available may experience frustrations leading to system dysfunction. A facilitator of competence development may serve to illuminate the options by intervening when the learner/system is unaware of the degrees of freedom or lacks the initiative to exercise them.

DSE functions. The "conceptual set" proposed by Kuhn (1974) for elaborating general system theory in a social context seems, in part, to be relevant to explaining the development of competence. Kuhn proposed that any controlled adaptive system must utilize information, preferences or values, and behavioral responses, which are handled respectively by detector, selector, and effector functions of the system (DSE). These intrasystem functions have intersystem parallels. Detector deals with information within the system, and communication transfers information between systems. Selector deals with values within the system. Transaction is value transfer between systems. Effector produces behavioral result. Organization is a joint production of an effect by two or more human systems. These concepts help in understanding the feedback interactions occurring at system boundaries.

Detector, selector, and effector functions provide the individual characteristics of the learner/system. In order for the detector function of the learner/system to grow and act effectively, a rich physical environment and human communication system must be made available for concept formation and attainment (Kuhn, 1974). The permeability of boundaries will influence the learner/system's perceptions of factors influencing detector functions. If accumulated experience fosters openness, this

behavioral subsystem will help in learner/system competence and development as the conceptual level increases continually.

Learner/system goals and judgments are based on the selector function. However, just because a learner/system likes or prefers something, does not mean that he needs it. A learning facilitator is one source of guidance when the learner/system is, for example, tempted to choose the easy or familiar learning mode. Measured amounts of positive feedback can inspire the learner/system to seek increasingly complex competence development. On the other hand, a learner/system's goals (career) may require a certain directed channel, thus, influencing learner decisions via the selector subsystem. Programming may condition the learner/system to select certain channels because of external rewards. Either of the last two selector functions may result in a relatively closed system if objectives are carefully defined without learner/system input.

The effector subsystem carries out the behavior. Motor behavior is influenced by concepts and goals (detector and selector), but concepts and goals are attuned by motor skills. One may understand and aspire to be a ballet dancer; however, without coordination, it is a fruitless ambition.

Ecosystem Conceptual Framework

Kuhn (1974) included three basic frameworks for analysis. To look upward to the large system of which an object is a subsystem and to examine the role it plays in that larger system is functionalistic. To look downward from system to subsystems which compose the system is

reductionistic. Both of these approaches focus on parts rather than the whole. To examine a system as a functioning unit is a holistic analysis. All are necessary, but it seems that the last is slighted in viewing the learner and the learning process and specifically in interpreting competency-based education from a broad perspective.

Attention has been given to many aspects of competence development, both before and during the CBE movement. Some educators have emphasized the need to look at competence development in its totality. Types of education increase as influences on learning are reduced (Cremin, 1976). The complexity of education must be viewed at all levels with a

> . . . range of education as they define their problems. The goal is not less definition but rather better definition in respect to the boundaries of problems and the particular phenomena deemed relevant and significant. (Cremin, 1976, p. 49)

Ecosystem theory, based on general system theory, is a unique way of viewing a totality. An ecosystem framework provides a neutral perspective to education. Thus, two goals stated by Cremin may be sought. One is that of establishing structures and methods that will assist individuals throughout their lives, and the other is to equip individuals to become the objects and the instruments of their own development.

An ecosystem conceptual framework provides a central focus and a means for examining the complex interactions existing in competence development. It does not yield to specialized learning theories or subject matter biases. It is interdisciplinary by nature. Ecosystem theory may be viewed as both holistic and contextual. It focuses on the totality as well as the component parts. It offers systematic means

of studying connections, interconnections, referents, and direction. It is multidimensional, not linear (Immegart and Pilecki, 1973).

The conceptual models illustrated in this paper are meant to be vehicles for visually organizing the complex ideas involved in an ecosystem configuration of competence development. Model 1 provides the global perspective, and Model 2 provides a focus for the process at a more specific level.

CHAPTER IV

COMPETENCE DEVELOPMENT: MODEL 1

Competency-based education came about in the effort to deal with multiple problems arising out of education in a changing society. The rationale for CBE reflects the intrasocietal interest and responsibility for establishing a set for learning in human beings and for gearing that learning toward the betterment of the individual and society. The importance of looking at the learner and the subject matter from a broad perspective based on societal needs has come to the forefront. An interdisciplinary approach to education has become increasingly popular as a means of interrelating educational disciplines to this end.

The broad goals of CBE and interdisciplinarity (ID) are similar; however, some differences exist between the two. CBE strongly emphasizes the recognition of the uniqueness of the individual learner. The concept of interdisciplinarity involves the recognition of individual uniqueness but by its very nature requires multiperson efforts. Each advocates predetermination of objectives and goals, with CBE delineating competencies as well, based on established though changing, learning criteria. CBE usually includes behavioral objectives. Interdisciplinarity, in its approach to many-faceted problems, provides a focus on interaction of individuals with competence in different dimensions and content and process factors infinite in number and changing as a group develops or changes membership. Goals may be set in advance, but means for meeting those goals must be flexible. In both CBE and ID, the learning process

is a factor which must be of equal or more importance than the content if innovations resulting from implementation of programs based on these philosophies are to progress and remain viable as individual and societal needs change and as technological advances become more than just appendages to the educational system.

What is needed is a holistic perspective in which the interrelationship of content and process factors may be viewed with the increasing complexity and change included as factors. Models 1 and 2 provide vehicles for envisioning the thrust of this complex perspective in an ecosystem framework. The reciprocal contributions of CBE and ID will provide a basis for describing the models' dynamics.

This chapter pertains to the major objective of this paper--to illustrate the development of competence from a holistic view while viewing the learner as interacting with the environment. Model 1, presented herein, is an illustration of the global nature of competence development based on ecosystem theory. Then, suggestions for implementation of Model 1 are given.

Introduction to Model 1

An ecosystem involves the interrelationships between an organism and its environment. This paper is focused on competence development in the context of learner/systems in interaction with their environments. Model 1 represents the idea that learning involves not only learner or environmental characteristics, as envisioned by theories supported by humanists or behaviorists, but also the interrelationships between these components as viewed by those focusing on person-environment interaction.

Model 1 illuminates the learning influences inside and outside the school setting.

Under consideration in this paper is an open system (a learner) in dynamic interaction with its environment. Growth is influenced by proximal and distal environmental factors as well as by intrasystem (subsystem) components. Competence is assumed to be a directed part of growth. Each learner/system seeks unique competence depending on goals. These goals are determined by the previous interactions between the system and the system's environment, with feedback constantly causing adjustments. The learner/system moves from relatively simple to increasingly complex interaction as it progresses through time/space. The system itself increases in complexity through growth. Model 1 (Figure 5) depicts the sources of input for system growth and change.

In the model, the near environment of the learner is subdivided into human interaction and environmental interaction. Each of these is relative in its influence depending on the system of concern. The two may vary considerably or be equal in influence on a specified learner/system. These portions of the model are surrounded by flexible (in size and permeability) interfaces to provide for expansion and contraction of influence on competence development in the learner/system. The input from these sources falls on continua from specific to general and single to multiple and will be tempered by the learner/system's values (depicted by a broken line around adaptation)--the selector function of the system. The system's relative openness influences the strength of these interfaces and their permeability. The kind and amount of competence sought by the learner influences the relative importance of various factors,

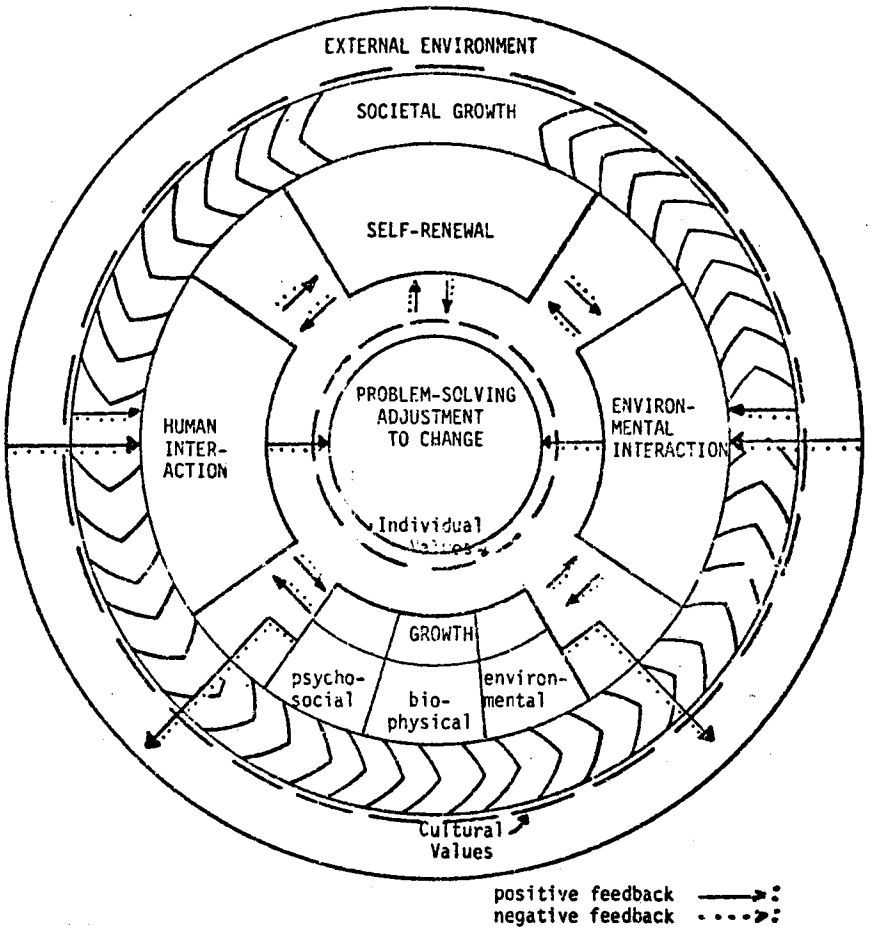


Figure 5: Model 1. Competence development with little human interaction.

thus, giving some factors more prominence than others. Consequently, what may be viewed as similar input from the environment into two systems may be perceived quite differently by learner/systems because of their different interfaces, boundary permeabilities, and DSE functions. An effective analysis of the learner/system by instructors can be diagnostic, thus, providing influential information to the learner/system through feedback.

The theoretical context of the learner as a system assumes goal-seeking learner behavior stimulated by feedback. Student growth toward goals is governed by the student's use of information from the environment. Often found in schools today are externally established goals. This situation results in a controlled system. The more open the learner/system, the greater the likelihood of internally established goals.

The setting for competence development in Model 1 is typically the school. However, that particular learning environment is only one part of the learner's total environment. Consequently, in designing a learning environment conducive to competence development of a specified learner/system, we must look at the reciprocal input and output between the system and suprasystem. For specified goals, specified competence will be sought by the learner. Consequently, each learner/system and/or instructor must undertake a look at the unique structure and the reciprocal relationship within a unique environment when organizing and designing a learning environment conducive to growth.

System Environment--Proximal and Distal

Competence development evolves from an accumulation of competence over time. With this accumulation comes also a broadening of influences outside the boundaries of the system. Hence, when looking at the total picture, some attention must be given to the societal influence. Educational values reflect cultural-societal values. Controversy looms as to whether society shapes education or whether the reverse is or should be true. Consideration should be given to the extent to which each is or should be true in the reciprocal relationship between the two. Without attempting to deal with this moot question, it is clear that an inter-relationship exists. As communication brings the world and its problems closer together and as many see an important role of education as that of dealing with such problems, a broad perspective is needed in the initial development of educational goals.

Model 1 illustrates the multiple-track output phase of competence development by showing the possibility of a learner/system's influence on societal growth. Also, information flows among components of the learner's near environment via human interaction and resource-environment interaction. For example, in an educational setting, the learner may be instrumental in determining the operation of the program through this interaction.

Competence development as a factor in growth must be viewed as a part of this complex ecosystem. To alleviate complexity beyond manageability and comprehension, the factors in direct relation to the goals of the learner may be specified. An advantage of using system theory in conceptualizing competence development is the ease with which the concepts

may be adapted as the definition of the system of interest is changed either vertically (hierarchically) or horizontally when the system grows or changes emphasis.

The State of the System--Biophysical, Psycho-Social, Aesthetic-Environmental

As shown in Model 1, the system may be described in terms of its biophysical, psycho-social, and/or aesthetic-environmental state. Each of these factors influences the effectiveness of planned competence development and the actual competence sought by a learner. They also influence the learner/system's perception of the learning which others direct. As the learner/system progresses toward goals, new directions or altered methods may be discovered and implemented, thus, directing the learner/system to unforeseen competence. Input from the suprasystem may influence changes in goals sought by the learner/system while the learner/system maintains the same purpose or overriding aspiration (J. G. Miller, 1965a). In system terms, accessibility of both matter-energy and information into and from the learner/system will be factors in the determination of system state. And, DSE functions are shaped in part by these factors.

A learner's biophysical condition--health, gender, hunger, physical appearance--influences abilities and interests. Priorities and goals may be determined in part by these conditions.

The psycho-social factors include attitudes and status as a member of numerous formal and informal groups. Again, the success in achieving competence and the choice of competence sought are motivated by this

factor. Communication skills and adaptation/coping skills may stem from the psycho-social nature of the learner/system. Physical environment, family, early socialization, and schooling help to structure this component. The complexity grows as the system matures. Learner-preferences and abilities reflect evolved psycho-social structure.

The aesthetic-environmental state contributes to system sensory perceptions. Learning strategies supplemental to competence development are influenced by this state, as will learner goals.

These factors must be viewed as dynamic, not static, and as interrelated. Through growth--competence development, specifically--each factor is changed or developed. As skill, appreciation, and/or knowledge are developed, the system's biophysical, psycho-social, and aesthetic-environmental conditions and perceptions are developed.

Elaboration could be extended (and has been by many educators, psychologists, and others) concerning these basic influences on competence development. The potential influences are infinite, requiring selectivity in assessing each learner as an ecosystem constantly interacting with the environment. Further reference will be made to these factors as specific analysis evolves.

Competence Development Phase of the Model

In Model 1 the actual process of growth in a specified learner/system is depicted in three sections. Self-renewal may be seen generally as a plateau, or a sorting-out phase. Actual competence development occurs after the self-renewal phase (if the self-renewal phase is indeed needed). The process may involve a subtle adaptive competence,

adjustment to change, or directed change toward specified goals. The change process is represented in the model by the center of the circle, termed adaptation, problem solving, or change. The point of assessment of an identifiable behavior change or measurable increase in ability to receive and process information is represented by growth. Growth, in general, is much broader and less predictable than formalized directed learning based on goals. Growth occurs even when the learner/system is not involved in a formalized learning environment.

Self-renewal. Self-renewal is the inner system process of dealing with positive and negative feedback. In terms of competence development, the self-renewal phase is not the measurable competence, in which assessment provides a profile of attributes for an interested party (an employer, for example). However, it may be viewed as a plateau, a source of contemplation, perhaps a lag time (J. G. Miller, 1965a). The lag time may consist of storing information until sufficient input can be put together to induce behavioral change. It is this phase in which the merits of positive feedback may be considered by the system. The effector and selector subsystems are functioning. Determination of system capacity for coping with positive feedback and seeking negative feedback as a source of regulation would occur in this phase. The influence of perceived degrees of freedom may be felt here.

Another need for considering individual differences in structuring learning environments may be based on the processes of this part of growth, this stage of competence development in particular. The system

variables and their relative importance to the system will influence the nature of self-renewal.

Gardner (1971) developed the concept of self-renewal in his book of that name. His discussion of self-renewal fits ecosystem theory as a framework for understanding growth. His discription of dynamism over deterioration exemplifies negentropic over entropic conditions, with an emphasis on individual initiative in a societal context. He predicted decay when individuals and institutions lose their vitality--respond to negative feedback predominantly. And, vitality is not restricted to youth.

> Does this mean that there is no alternative to eventual stagnation? It does not. Every individual, organization or society must mature, but much depends on how this maturing takes place. A society whose maturing consists simply of acquiring more firmly established ways of doing things is headed for the graveyard--even if it learns to do these things with greater and greater skill. In the ever-renewing society what matures is a system or framework within which continuous innovation, renewal and rebirth can occur. (p. 5)

John Dewey (1944) explained renewal of life by transmission as a purpose of education. Dewey proposed that living beings turn energies which act upon them into means of furthering their own existence. They use surrounding energies in their own behalf. Acting on the environment results in growth of the living being. Renewal is not automatic. Continuity of life requires continual readaptation of the environment to the needs of living organisms. Dewey's point of view accommodates ecosystem theory and Gardner's idea of self-renewal. Self-renewal in Model 1 is a part of the processes explained by each of these authors.

Adaptation--adjustment to change. Central to the global model of competence development is adaptation--adjustment to change. Kuhn (1974, p. 40) called adaptive behavior "behavior of a system in an environment." This includes competence development as a factor which in turn affects system growth and stimulates the dynamic action of the processes represented by Model 1.

Piaget's (cited in Ginsburg and Opper, 1969) theoretical framework includes adaption as a factor which affects intelligence. Earlier in this paper (Chapter II), the complementary processes of accommodation and assimilation were explained as processes involved as a person interacts with the environment.

Adaptation is a process. System concepts directly related are homeostasis and steady state (Buckley, 1968). Adaptation may be looked upon as a correlate of change, hence, a part of the same section of the model. Competence development involves change; however, systems dealing only with change (i.e., change for change's sake) represent a disproportionate amount of positive feedback and tend to be relatively entropic. A balance of regulated change and system maintenance will alleviate the extremes of too much or not enough import and export of usable information or matter-energy. Kuhn (1974) emphasized that the system cannot respond to its environment unless it processes information about it. Many of the failures in education and some of the frustrations may be explained by inability or lack of sensitivity to adaptation in both general and specific contexts. Berrein (1968) said that adaptation is "a survival-extending process and occurs when a potentially harmful maintenance input (an error) from the suprasystem is blocked or

dissipated at the boundary or neutralized within the system" (p. 136). Permeability of boundaries is a factor in adaptation as are the DSE functions.

In competence development, adaptation may be facilitated by the availability of a multidimensional learning environment and its facilities. With this, the student may maintain a steady state by being in the proximity of conducive learning modes and content. Steady state is particularly appropriate to adaptation concerning competence development because it allows for change to occur in an open system as a means of maintaining a steady state (Buckley, 1968). Adaptation may change the structure of the system. As one competence is achieved, it provides for feedback for moving on in content depth or process complexity. If adaptation is not nurtured by providing for this growth factor, the output from the system will be cut off. Without output, growth is minimized.

Competence in coping with change may be developed with the planned extension of environmental dimensions. However, homeostatic conditions must be developed which help to secure a balance, thus, contributing to the coping skills. Maintaining some remnants of previous but similar experiences as change is occurring is perhaps more easily achieved than are totally new experiences toward competence. This will vary with the learner/system. When the student suddenly has no deadlines, no grades, and no specified teacher or classroom, competence development is likely to come to a halt. Those students who do survive such upheavals probably do so because they have internal steady state devices which help to allow the system to continue to grow, or they will develop these devices as a function of adaptation.

Learner/System Properties

The relative openness of the system is a primary system property. The goals of the system--the type and degree of competence sought and developed--will be determined by the degree to which the system is open. The openness may be depicted by the designation of and permeability of system boundaries.

The flow of information through these boundaries will contribute to the level and type of content and processes relevant to the growth of the system. An "ideal" system structure would be relatively open and, therefore, open to growth. How much input can the system process without feeling stress, being unable to cope? At what point will entropy develop because too little receipt of information or too much, thus, promoting nongrowth or chaos? This state of affairs is depicted by the type of input perceived by the system--the balance of negative and positive feedback with which the system can deal, given its DSE functions. Each system will vary according to past experience, present environment, and future goals.

A relatively open learner/system in a learning environment of higher education aspires to goals beyond a balance depicted by equilibrium. Rather, a steady state is sought, whereby, input from the environment and output from the system allow maintenance of a steady state which is characterized by change. The degree of change with which the system is able to cope may be seen as a function of the amount of positive feedback with which the system can cope or the relationship between positive and negative feedback. Because competence development has been designated as planned change, the learner/system and instructors of competence have the

mutual goal of increasing the level and type of competence.

From a system perspective, the change sought is recognized as multidimensional rather than linear. Interaction with all components of subsystems and suprasystems must be considered as influences. Given an initial structure perceiving linear growth (e.g., increase in knowledge of content), the system may be relatively closed, requiring homeostatic influences (input from the environment) as means of maintaining a steady state. An example of homeostatic influences might be grades or other means of extrinsic motivation such as meeting a pre-established criterion level.

In a changing society a learner/system must adapt to a broad type of change. Competence development must be expanded to include the preparation for dealing with the change and complexity which occurs when formal learning subsides and the learner continues competence development independently. The learner/system must continue to grow and adapt in order to prevent entropic tendencies evidenced by not keeping up with a career or personal needs as a member of society.

Equifinality is a concept particularly applicable in viewing competence in an ecosystem framework. In developing competence, this process must be recognized early in the learning process. The homeostatic devices available may be overgeneralized to learners in a specified level or area of competence development. Perhaps getting high scores or meeting a specified criterion level will stimulate the learner to continue, but the learner may need a different procedure to allow for multidimensional growth, including self-reflection, creativity, and integration of learning. Consequently, a variety of facilitators, with interaction which

is environmentally stimulated and interaction which is learner/system-stimulated, should be sought and assessed.

As noted previously, the structure of the system is relative, and with growth, change is necessary. This suggests the need for careful assessment of homeostatic and equifinal devices which allow for increases in ability to adapt with change. If the learner/system is looked upon as static and if information continues to be exchanged in a similar manner, growth may subside or at the most be linear. The more the system is controlled, the less growth may be realized. A learner/system structure profile viewed in interaction with career or general learning goals--an assessment of the type of information and matter-energy the system uses and the way it is used--would provide a basis for planning future competence development in light of system and societal change influencing career goals or growth.

In other words, the multidimensional components of Model 1, which are means to depict the complexity of competence development in a changing society, requiring coping with this change, are not meant to purvey any kind of set or ideal. Determination of the set or ideal and the relative importance of each component will be dependent on the system structure at intervals in the formal learning of the system. Hence, competence assessment is a source of feedback. Assessment of competence at intervals from a multidimensional perspective can direct the on-going process. This assessment can provide input to the learner/system as well as to the facilitators. The compatibility of learner/system, content, and process requires assessment. The cross-sectional as well as longitudinal feedback sections are shown in Model 2.

In applying Model 1, one would identify the system of concern and the relevant objects in the environment along with the relevant attributes of the objects and their interaction with the given system. Thus, the problem is simplified. As competence increases, new variables and interrelationships must be identified. As J. G. Miller (1955) stated, "Assumptions or other aspects of the model are altered to include new parameters or variables, in order to predict phenomena more accurately" (p. 523). A relevant reminder of Kuhn's (1974) is that "strictly speaking, it is the variables of the system, not the system itself, that are in equilibrium" (p. 47). With this in mind it is easier to see the necessity of changing process and assessment procedures as variables change and/or become more complex.

The proximity of interacting systems is a factor in the progress of system growth. The hierarchical nature of the suprasystem and the proximal and distal placement of environmental objects are illustrated in Model 2. Information flow is likely to be perceived more accurately across proximal boundaries. However, the importance of communication of information between a system and distal boundaries must be acknowledged. The possibility of "noise" accompanying or displacing information increases with distance. The necessity of crossing several boundaries before reaching the system is a well-known phenomenon and is a sure way to distort information or deprive the system of information. The output from the system is equally subject to distortion. In a formal learning setting, the administrative hierarchies must go through at least one filter of information (instructor) to reach the learner. The more unique the DSE functions which are operative, the greater is the likelihood of

distortion. Direct communication with the learner is seldom a reality.

The complexity of such a situation may be viewed in nearly any major administrative change affecting a learner/system. Not only is the difference in location of the systems involved a factor, but also the conceptualization of problems perceived by the interacting systems (DSE). Then, transferring goals down to the learner/system is an additional source of confusion dependent to some extent on the relative permeability of the boundaries involved in the interchange. As the world becomes smaller and the population increases, the complexity of this dilemma becomes more obvious. A prototype of the "smaller" and more complex world is a college within a university which is dealing with change in structure. If the boundaries of the learner/system are such that it cannot receive information from the instructor or administrator in the school, that learner/system will be subject to entropy. If the learner/system has permeable boundaries and/or many interfaces with environmental components, information may be perceived by the learner which will allow the learner to adapt to the environmental change. Such system properites can be developed in the learner/system's environment by offering multiple opportunities. If one source of information cannot alleviate the entropic tendencies in the learner/system, perhaps another can. Most helpful is a system which has many interfaces with the external environment. If a system profile is maintained, whereby the competence at the particular interval where stress (i.e., new information not clearly perceived by the system as compatible with its current status or set) is noted, a facilitator (instructor) may identify the type of information or matter-energy which would be used to intervene successfully. The intervention

might be characterized by reduction of positive feedback or more careful identification of appropriate negative feedback. Not only is a steady state achieved within the subsystem, but also between the system and the facilitator or source of excess positive feedback.

The necessity for constant evaluation--summative as well as formative--has been noted by most educators. Because evaluation is not easily quantifiable, an increasing concentration of efforts toward open boundaries facilitating open interaction among the learners and the instructor(s) must be sought. A unilateral approach to teaching cannot achieve this reciprocal information exchange nor can excessively large groups which interact neither with instructor nor with each other.

Application of Model 1

Model 1 (Figure 5, page 71) is designed to allow for the varying importance of the components of the learner ecosystem. These components, then, vary in structure. And, with the interaction among these unique structures, innumerable sources of individualization for the learner/system exist before taking into consideration the learner's own intrasystem uniqueness. This individualization emphasizes the need for consideration of individual differences influencing competence development. In implementing the flexibility of the model, the character and structure of that individualization can change in time/space simply by the change in relative importance of the external environment in general.

Model 1 is shown in Figure 6 with a disproportionate emphasis on the external environment. With this state of affairs, the individual and the near environment are minimized. The learner receives little

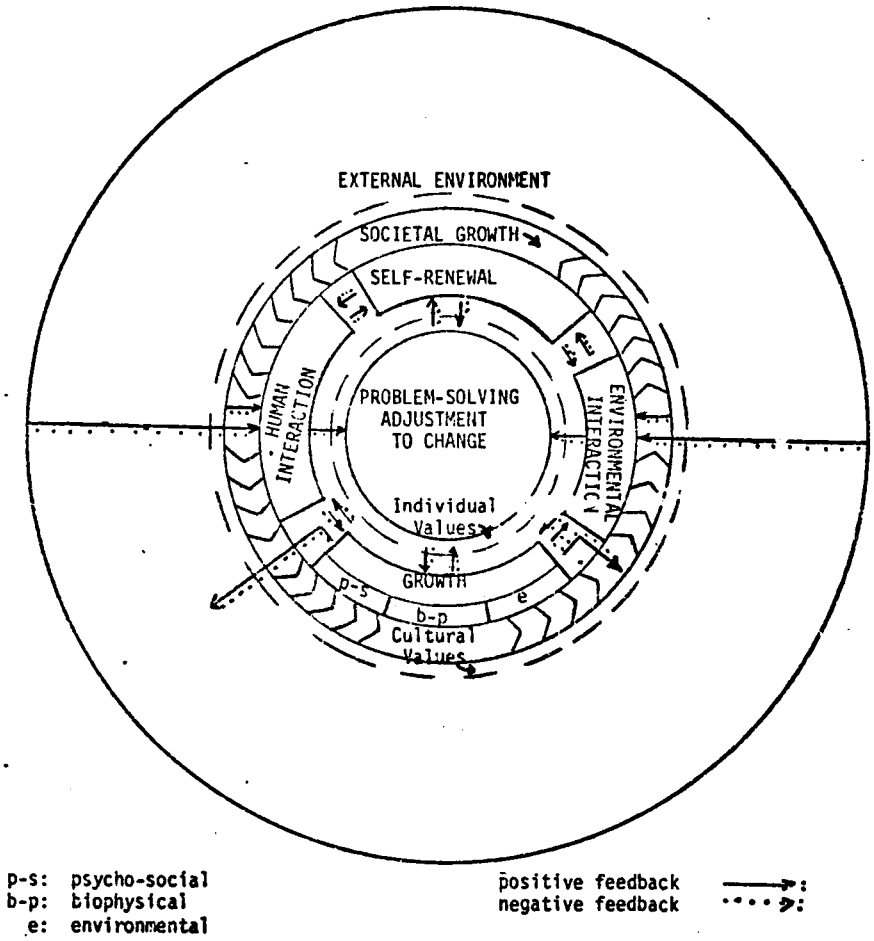


Figure 6. Model 1. Competence development with excess external influence.

information from the near informal or immediate formal learning environment. Variations in adaptation from learner to learner are less unique because of the uniformity of information input from the external environment. Creativity is not promoted or detected. As learner growth is minimized, so is societal growth. A learner who functions as a relatively closed system results--one who processes only the information received out of direct contact with the system. (The distance can be manifested in social or psychological distance--i.e., lack of communication or information overload--as well as in physical distance.) The learner/system receives more information than it emits. Because selective growth (appropriate to the learner) is not promoted, entropy is more likely. If the content and method imposed on the learner happen to fit a learner set (structure), growth can occur, but the number of learners for whom creative growth actually occurs is decidedly reduced.

A similar result may be envisioned when one component of the learner/system's near environment takes on disproportionate importance. An example might be any one of the so-called educational "panaceas" which have been emphasized from time to time and which are manifested in many ways. Two different types of illustrations are educational technology and overgeneralized application of new research findings or government task force findings. More specifically, audio-visual materials or programmed instruction which work in one school, at one time, for one learner, at a given stage of development, and in a given subject can lead to general growth or specific competence development. They can, however, be dysfunctional in the wrong setting. Gilley and French's (1976) study represented the need for emphasis on looking at the learner DSE functions--

how the learner receives information as well as how the information is processed by the learner. An equally detrimental state of affairs is failure to recognize that with growth (hence the development of specified competence), the learner experiences change in structure (change that cannot be predetermined if the learner is a totally open system); therefore, audio-visual materials which may not have been effective at one age or in one subject might be effective at a different age in a different subject. The use of multiple-choice tests may provide a necessary amount of negative feedback to maintain a system steady state at one point in time. Continual use will eliminate receipt and processing of increments of positive feedback possible through varied means of assessment.

Overgeneralization of instructional methods and assessment assumes similar input and use of information by all learners. But, this will reduce output from some learners depending on their DSE functions and information-processing capacities. In turn, the learner/system's perceived control of the environment is potentially predetermined, thus, affecting the degree to which the learner acts as an open system.

As the need for directing some learning formally is recognized (hence, designation of competence development toward goals), careful assessment of individual learners will help to detect the competence level achieved so that further growth (competence development) is not hampered. Essential in this assessment is the maintenance of the permeable boundaries and numerous interfaces with many segments of the external environment only to be detected from analysis of individual learner competence at a given time.

In a different vein, external environmental conditions may be means of positive feedback in the sense that content and approach must be changed if formal education is to remain viable to individual or society. Interdisciplinarity is an example. If permeable boundaries and flexible interfaces are not maintained among near and external environment, near environment and system, and system and external environment, the changing nature of societal concerns will go undetected or be incorrectly perceived.

A similar state of affairs is the disproportionate emphasis on input/output involving external environment depicted in Figure 7. Here, the system has not maintained interaction with the external environment. This may be an initial state of affairs or the result of the occurrences cited in the discussion of Model 1, Figure 5, page 71.

Little consideration of external input cannot be judged "good" of "bad" without consideration of learner goals. Much traditional disciplinary learning relies on externally directed learning, thus, discouraging the development of an open learner/system with constantly maintained open boundaries with external environment. The same may be true of interdisciplinary learning, if traditional procedures were used. And, the impact of input into societal growth could be seen as minimal or as excess positive feedback promoting inappropriate change. Entropy could occur in the learner/system, the learner's near environment, and/or society, depending on the impact of the external input.

Just as the open system represented in Figure 5 involves some directed growth, Figure 7 may be an appropriate system structure during some stages in competence development. The proportionate influences in

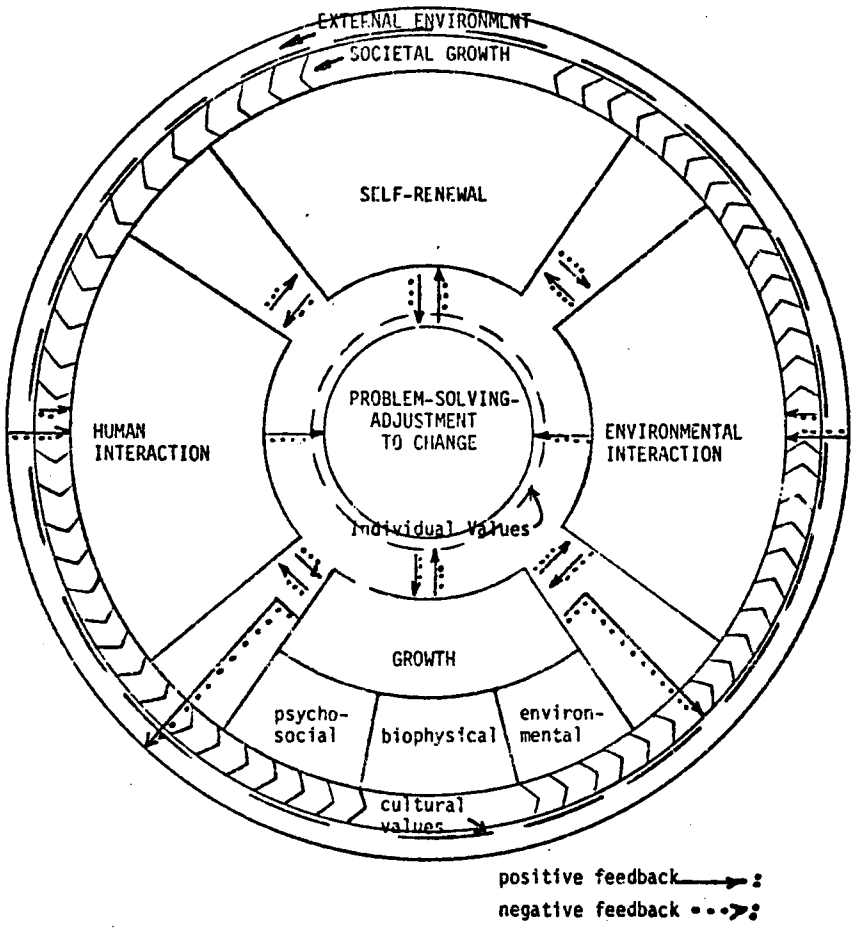


Figure 7. Model 1. Competence development with excess near environmental influence.

Figure 7, page 90, may be perceived as sources of negative input for maintaining a steady state. Or, in the case of an artist, for example, Figure 7 shows that a period of contemplation or processing of positive feedback may be sought. This viewpoint emphasizes the need for a dynamic model and one which allows varying foci.

In Figures 8 and 9 the disproportional input of components of the near environment are seen; neither of the figures is meant to represent a dysfunctional status for the learner/system. It seems typical and appropriate in a relatively free society with consideration of developmental sets in learners that input emphasis would vary during change. A relatively open system actually may be interacting selectively with all parts of what appears visually to be a lopsided environment. Goals are set by recognizing compatibility with certain environmental factors.

The negative aspect of the visual interpretation occurs when the learner/system interfaces selectively with one part of the near environment while closing out another. We have an endless list of such occurrences of tunnel vision. In an interdisciplinary learning environment, it is essential to the viability of the program to direct the learner consciously to envision mutual interactions among all parts of the ecosystem of concern. As the interests may be directed in one area, the influences of other components of the system are received and processed less directly.

The discussion concerning Model 1 has focused on the importance of looking at competence development from a global perspective. When interdisciplinary problems are of concern, the relevance of such an approach seems even more obvious--for both the approach to content and

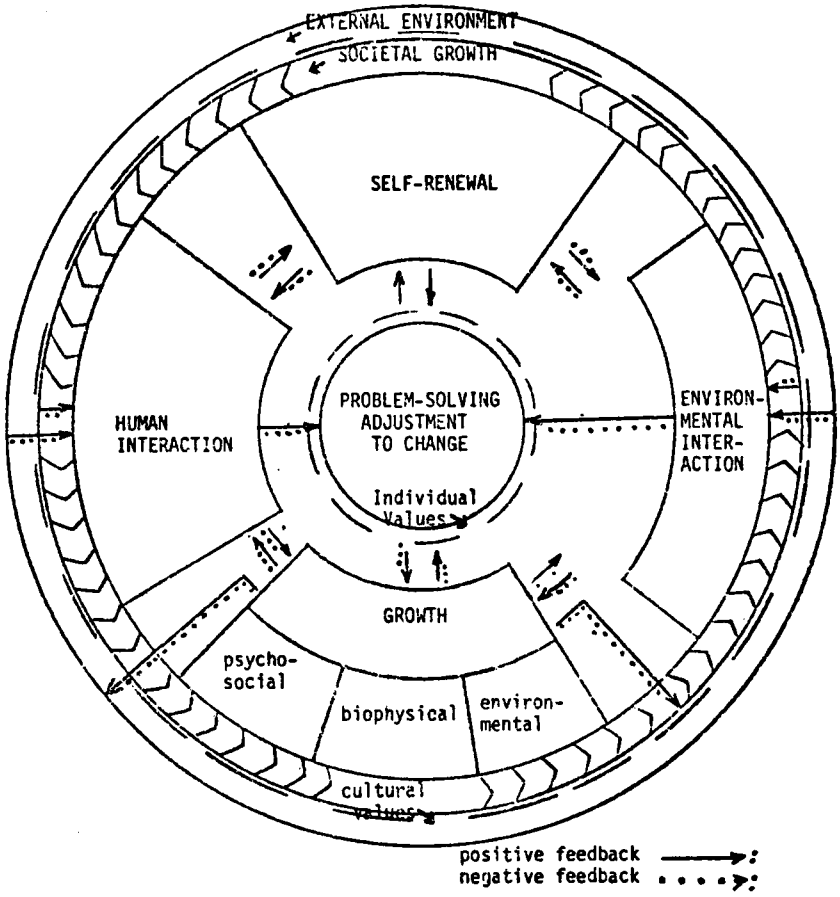


Figure 8. Model 1. Competence development with little environmental interaction.

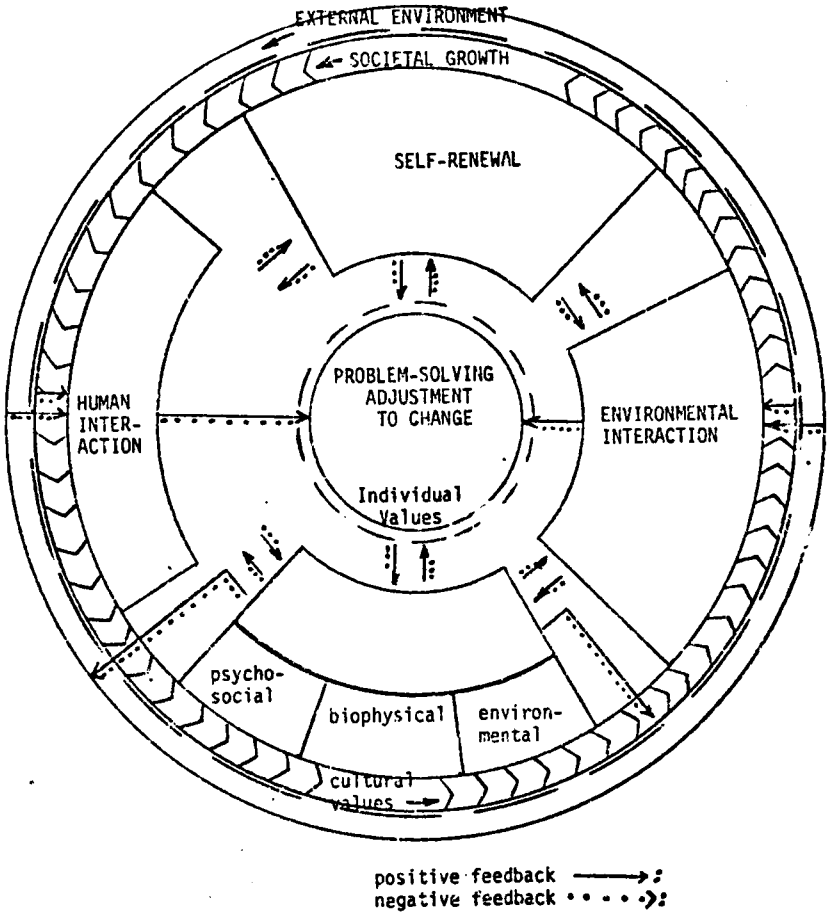


Figure 9. Model 1. Competence development.

to the process. This global approach is intended to illustrate the objective of designing a model conceptualizing competence development from an ecosystem perspective. It also sets the stage for the actual process of competence development represented in Model 2.

CHAPTER V

COMPETENCE DEVELOPMENT: MODEL 2

Introduction to Model 2

Empirical data are abundant in all aspects of education. Theories abound from numerous vantage points which support and reject empirical findings. The multiplicity of elements involved in the learning process makes it difficult to comprehend a total picture. Societal change adds a relatively new element which requires more than a static estimate of the quantity and quality of education. Discussion of the merits of placing certain emphases on learning leads to a stalemate because each point of emphasis demands attention, in a focus not reflecting a hierarchy of factors but a recognition of the equally important roles of many factors. General system theory provides a perspective for viewing a totality and giving equal time to components, in that interrelationships are emphasized without placing biased and, therefore, higher value on one factor or another. Ecosystem theory provides a version of general system theory which recognizes the relationships among living systems (organisms) and their environments. Thus, it provides a framework relevant to education.

Competence development is a goal in formalized education which epitomizes the varied emphases and discussions noted above. In a changing society, a neutral, dynamic framework is required for directing and assessing the process of acquiring competence.

A global perspective for viewing the learner as a system and the varied environmental influences is provided in Model 1. In Model 2, Figure 10, a more intense view of the actual process of competence development for specified individuals is provided. Given a pluralistic attitude toward competence development, an ecosystem framework offers a means of viewing all integrated factors but on an individual learner basis. Critical ingredients will vary in time/space and with specified learners and investigator interests.

Two major objectives direct the design and use of Model 2. The first objective is to provide a structure which includes the variables deemed operative in competence development. The second is to present a dynamic rather than static perspective for understanding competence development. A permanence of structure is not intended. In viewing the learner as a relatively open system, certain characteristics are assumed which require a dynamic structure for mapping the competence development process. It is assumed that as an open system, the learner/system is constantly exchanging energy and/or information with the environment. This exchange includes energy and information directly and indirectly affecting competence development. The amount and quality of energy and information exchanged among the other systems within the learner/system's environment affects the learner/system. The open learner/system will fluctuate in the amount of information and energy which may be stored, thus, warding off entropy. Variance will occur in the amount and type of energy or information exported to the environment. In turn, the speed and coherence of this cycle of energy-information exchange changes. The relative dependence on negative feedback or adaptation to positive

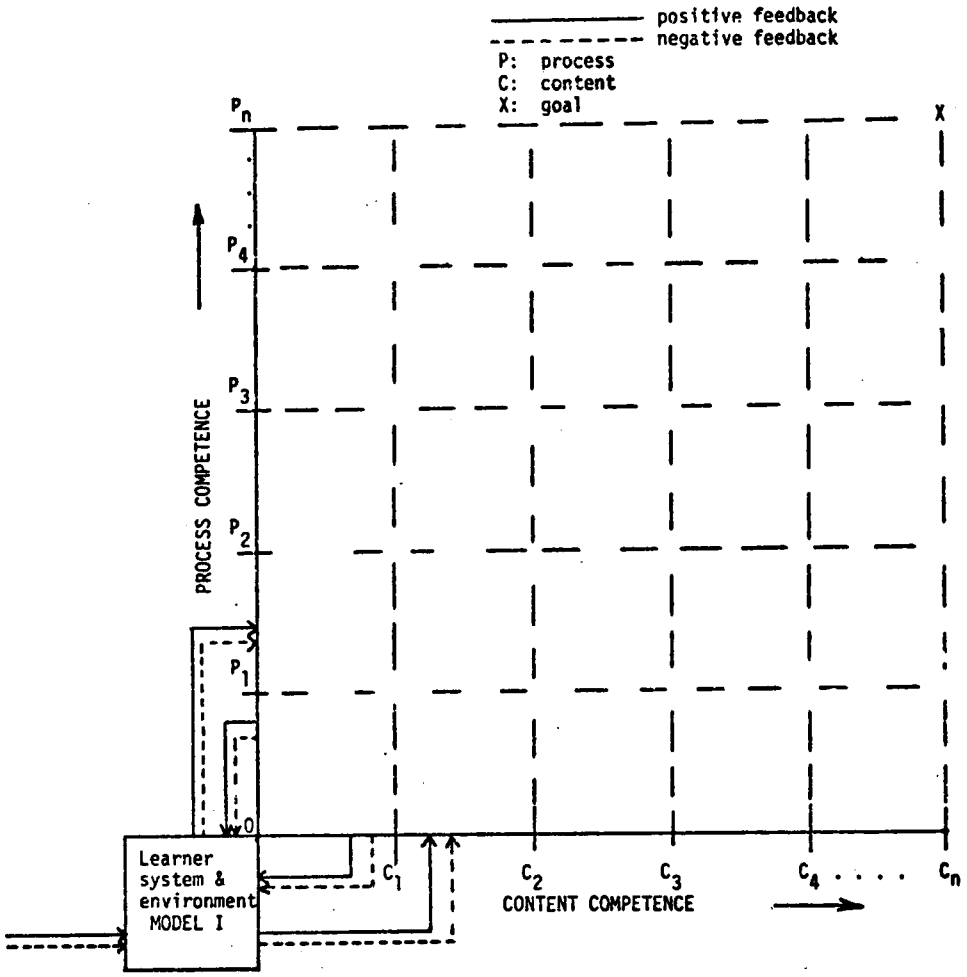


Figure 10. Model 2. Process/content competence.

feedback also helps to illustrate the vast and dynamic nature of learner/systems. It is in accordance with these and other fundamental ecosystem concepts that Models 1 and 2 are to be viewed.

In viewing the learner as an open system, it is important to recognize that environmental influences are not just sources of error variance but are integrally related to system functioning. To understand an open system is to consider all forces that interact with it (Katz and Kahn, 1971). The relativity of each system concept is another point worthy of emphasis. Both the learner/system and the competence facilitator must be sensitive to the relative nature of the process of competence development and the system concepts representing that process.

The relativity of open systems must be recognized. As functioning human beings, all learner/systems seeking competence in school are relatively open. However, the structure of the physical facility, the administration, and the faculty, as components of the learner/system's environment, continually affect the actual and learner/system-perceived openness.

The ultimate in competence is achieved through providing an environment for maintaining a high degree of actual and perceived openness. This learner/system state is characterized by flexible and permeable boundaries interfacing with many environmental systems and the capacity to deal with a relatively large amount of varied positive feedback.

It is assumed that competence is multifaceted and occurs continually in all people. All competence development is dynamic and is reflected by change in an individual. Competence development may be as

subtle as maintenance of an already acquired competence in an individual's continually changing perspective. At the other end of a continuum of dynamic competence development may be a student reaching from one degree to another, making major adjustments to more dramatic competence development. A basis for viewing competence development at any level, from any point of view, is provided in Model 2.

The boundaries of this learner/system are defined according to the variables being considered at a given time and place. Typically, the learner/system boundary is delimited by the student role. Model 2 is intended to emphasize less tangible variables, too, in defining the learner/system boundaries. The selected variables within the boundaries are determined by learner/system's diagnosed status in process and content competence. The components included within the boundary of a system are selected because of the determination that more energy is exchanged among these variables within the boundaries than there is interchange of energy across the boundaries. The boundary must be constantly adjusted as changes occur (Chin, 1969). Much educational research reflects careful exclusion and inclusion of selected variables when studying student learning. A system conceptualization requires that the total perspective be maintained as selected variables are studied.

Competence development implies dynamic change. Learner/system state changes with time. A diagnosis of the learner/system at a given place in time/space provides a basis for selecting boundaries directed to continued change.

Multidimensional Competence

In this paper competence has been designated as the goal in formal learning as depicted by two multidimensional models. Competence definitions were given in Chapter III, representing the views of educators and psychologists with varying vantage points within and outside CBE. Each CBE definition represented some standard by which performance or achievement could be measured. Other definitions included specification of stages of learning or development at certain points in time. Formal learning must be measured in today's society, thus, providing a record of educational status. Heretofore, the measurement has been reported primarily in terms of grades. Grades represent the relative position held by a student in relation to other students in one class. Students too often aspire to grades, not content. And, content has been the primary emphasis of educational efforts as opposed to process.

The idea has been developed in this paper that competence is a bench mark--a measurement at a given point in time/space, or a recognition of specified skills, knowledge, or attitudes. It is a major source of feedback for guiding further competence development. Equally important has been measuring multidimensional qualities of competence. The rationale behind this approach is based on the assumption that learning is a complex process, what is to be learned is based in a complex environment, and the complexity increases. Learners' attributes change throughout time/space. Students require learning environments which are not only conducive to their own changing structure but also to the exponential growth and change of the society with which they must deal.

Hence, the bench mark--measure of competence--must guide the learner and other interested parties, through feedback, not only with what content the learner can deal and on what level, but also about learner capabilities in processing new information, working with other people, and integrating concepts. Competence is a major feedback mechanism of both content and process competence. An environment must be provided which facilitates the development of this multidimensional competence. Periodic assessment at intervals appropriate to the specified learner will provide a composite or profile which may be used as a source of feedback.

Content Axis

Content is a typical component of competence. In Model 2, content is depicted as one major axis for measurement. Measurement of the degree of sophistication acquired in dealing with the content of a discipline is depicted on the horizontal axis. Initial measurement (pretest, former grades, grade-point average) defines the learner/system's state of knowledge and represents a point of departure for further exposure to that content. Textbooks and lectures are typical means for furthering content sophistication.

With increased learner/system sophistication, the boundaries develop increasing receptivity to potential complexity of content from a wide variety of sources. As long as the content is perceived by the learner as relevant, he/she will process information received from the content environment. When the learner/system no longer maintains this interchange, competence in subject matter will reach a plateau. With

negative feedback, the learner can maintain that degree of content competence. For example, a learner may assume a career where this knowledge is used constantly. For knowledge to build, the learner/system must receive an appropriate amount of positive feedback to stimulate building on the knowledge acquired. Negative feedback may work up to a point in time when the maintained knowledge is no longer relevant because of environmental change--change in technology, values, or societal needs. A high degree of process competence may enable the learner/system to cope with the needed change in attitude or capability in content. And, an interrelationship between content and process unfolds. Interfaces are selectively maintained with sources enhancing the sophistication of content and process.

The degree of competence acquired in subject matter could be very limited. With a narrow learning environment, the learner would not be receiving alternate environmental conditions for growth in subject matter sophistication. This could be a basis for limited learning of content. This limitation has been realized by many educational researchers and has been transferred to many subject matter fields. The review of literature revealed the attention given to individual differences in approach to learning. Lack of development because of inappropriate environment may be perceived by the learner as low degrees of freedom or as an inherent lack of ability in the content area.

Interdisciplinary. Content competence may be expanded in Model 2 to include an interdisciplinarity perspective. The importance of a global (ecosystem) framework for viewing competence is magnified when there is a

perceived increase in number of interacting content systems. The complexity of conceptualizing a learner/system's role and knowledge is increased. The importance of identifying and assessing boundaries is increased.

Boulding (1953) stated that growth occasionally stops because of closure. Increased competence in one dimension alone may close out multidimensional growth necessary for coping with dynamic societal change. A concentration of competence in one discipline may minimize a vision of one's competence in a more global perspective. The stability maintained in an individual may minimize recognition of the need for an interdisciplinary perspective, or, bring recognition of the need for interdisciplinarity.

Doyal (1974) expressed the limitation of a multiperspective approach to content. He suggested the importance of an integrative scheme running throughout courses which could provide the desired synthesis. Permeability of interfaces among disciplines can only be realized by placing these disciplines in the context of their conceptual and methodological connections with other disciplines (Doyal, 1974). The "core" concept has tended to maintain the disciplinary boundaries. Taschdjian (1972) suggested requiring courses in system theory or information theory as means of bridging the various disciplines related in an interdisciplinary focus. Jantsch (1972) proposed an inter- or transdisciplinary approach to problems to minimize rigid polarization across disciplines. The attention given to interdisciplinary research and learning emphasizes the need to include the process component in understanding interdisciplinary competence development.

Kuhn's (1974) DSE functions may be perceived as intersystem as well as intrasystem variables and, thus, relevant to understanding interdisciplinary competence development. His translation of these concepts was discussed in Chapter III.

Process Axis

Model 2 is intended to convey the increasing number, complexity, variety, and integration of competences achieved by a learner/system. Seeing the learner as a system in an environment (an ecosystem), it is possible to distinguish and interpret the uniqueness of the learner by using system concepts.

The vertical axis of Model 2 depicts process. In an ecosystem framework, process is change of matter-energy or information over time in a system (J. G. Miller, 1965b). Process was further defined by Miller as including the on-going functions of a system. Process also includes history, which is less easily reversed than functions. History involves change resulting from learning which is not later forgotten. Processes change structure (J. G. Miller, 1965b).

The vertical axis of the model represents increasing complexity of process in competence development. The process of competence development involves change in complexity of system structure with greater complexity in competence sought. An environmental component is assumed in the process axis in that increased competence involves dealing with an increasingly complex environment. Thus, information-processing skills within the learner increase in complexity.

In the ecosystem conceptualization of process, change reflects interchange of matter-energy and information between learner/system and

environment. Learning processes will be developed by feedback and, thus, may be static or dynamic according to the nature of the feedback. In competence development the nature of the feedback will determine the extent of development allowed.

Jantsch (1975) emphasized the necessity of viewing process as determining structure, rather than the reverse, if the system is to continue toward multidimensional growth. Competence development is planned change, directed by learner/system goals; therefore, the environment can be assessed and designed to further multidimensional competence. A measure of competence would be a measure of both content and process and their interrelationships. Model 2 will assist in denoting the state of a specified system. White (1959) emphasized organism-environment interaction in explaining competence. Competence in this light is effective interaction with one's environment. Competence development can be both exploratory and selective. Mutual feedback between learner/system and environment insures system openness--a goal of competence development.

If multidimensional competence development is to be instilled in a learner as a continuous process, continuing measured positive feedback must be exchanged in order for growth to continue. Jantsch (1975) emphasized the contribution of entropy as a possible means of stimulating continuing growth. An entropic state could provide the stimulus for creating a new structure. If competence is measured periodically, the structure of the learner/system may be determined so that positive feedback can provide stimulation for growth without causing chaos or system breakdown.

Development may be broadly subdivided into psycho-motor, cognitive, and affective as it has been by educators such as Bloom (1956) and Krathwohl et al. (1964). Each of these could be seen as developing in complexity. Schroder, Driver, and Streufert (1967) described increasing cognitive complexity in terms of level of information processing and environmental complexity. The two integrate to form the learner's conceptual level. These researchers have shown that, as individuals vary in conceptual level, they vary in the degree of environmental complexity with which they can deal.

Relatively simple environments offering simplified information do not stimulate increasingly complex conceptual level. The above occurrence can be explained with the principle of negative feedback. To break this plateau or status quo, measured increments of positive feedback could be relevant to increasing conceptual level. Or, a change in student DSE functions could provide student perception of greater degrees of freedom, hence, greater response to increasingly complex information. Reference to Model 1 will recall the function of self-renewal in competence development as a period of personal assessment and direction to change.

Schroder, Driver, and Streufert (1971) have shown the opposite extreme--that of exceedingly complex environments requiring high degrees of information-processing skills as detrimental to the point of reducing conceptual level. The principle of positive feedback beyond the level of learner/system adaptation skills exemplifies this occurrence. The resulting system chaos may lead to entropy--reduction of information-processing capacity. As the learner experiences entropic conditions, the

tendency is toward absolutist and evaluative attitudes (Schroder, 1971).

The integrated-conceptual-level thesis of Schroder, Driver, and Streufert (1967) is supportive of an integrated assessment of process and content competence. The Model 2 grid provides a map for determining not only where the learner begins, but also the course that is taken toward increasing competence. Plateaus in learning may result from having reached an optimum level of environmental complexity based on conceptual level.

An ecosystem theoretical framework offers an approach for determining reasons for increasing or leveling off information-processing skills and degree of progress toward integrating process and content. Viewing learner history, environment, and current structure can offer insight into the perceived degrees of freedom, level of adaptation, and relative openness, hence, including factors other than compared innate intelligence as means for intervention decisions.

The leveling off and decline of information processing at a given degree of environmental complexity shown in U-curves by Schroder (1971) could be explained by negentropy reverting to entropy as maintenance level negative entropy or confusion level of information overload are perceived. The initial point of decline on Schroder's U-curves would be an interesting point of learner/system assessment. An assessment of learner/systems at the points of decline in the U-curve can provide information to the learning facilitator for directing further competence development.

Schroder (1971) wrote of dispositional factors which limit the level of conceptual complexity in a learner and, consequently, the degree of environmental complexity with which the learner can cope. Past

experiences establish these dispositional factors. A U-curve illustrates that both low- and high-conceptual-levels reach a plateau or maximum complexity, after which chaos develops; whereby, the learner no longer exhibits increasing levels of conceptual complexity in dealing with increasingly complex environments.

Jantsch (1975) theorized that introduction of temporary entropy is desirable as a means of counteracting the tendency toward organization at increasing levels of system complexity. Organization in this context increases stability and is maintained by negative feedback. Introduction of positive feedback tends to be initially entropic but may be a stimulant for further growth.

One interpretation of the process axis of Model 2 is from high-structure environment at the base to decreasing environmental structure toward the top. Hunt and Sullivan (1974) saw degree of structure as a basic dimension of environmental variation. A highly structured environment is determined primarily by the training agent, with the learner having little responsibility toward environment--a homeostatic tendency. This represents a relatively closed system. In a low-structure environment, the learner is at least as important as the training agent in determining the environment. An open system is more readily maintained with information exchange between learner/system and environment.

Process was explained by Schroder, Karlins, and Phares (1973) as being the self or personality facet of human development. The learner must learn how to put things together. The enabler is an environment which stimulates a search for information to be used by the learner to form independent ideas. The learner/system's DSE functions are developed

as filters between stimulus and response. Hunt and Sullivan (1974) proposed that low-structure environment is conducive to this outcome.

Hunt (1975), in describing both contemporaneous and developmental objectives, emphasized the importance of recognizing contemporaneous learner characteristics. Placing a learner/system in a low-structure environment could result in too much positive feedback without stability, thus, creating entropy and minimizing system growth. The process approach must be developed from a learner's identified state of process competence. Hunt's conceptual-level matching model allows for identification of learner competence in terms of conceptual level, starting with a highly structured environment if necessary as a source of learner-appropriate negative feedback.

It is important to recognize that complex information-processing skills should not be termed "good" and unilaterial processing skills "bad." The quality is determined by learner goals and structure at point of assessment. This idea provides for the appropriate use of diverse learning theories, depending on learner structure and on criteria applied.

The ecosystem framework provides a structure for delineating the observation of information source and flow which influence limitations in competence development. Success in achieving multidimensional competence varies from system to system and characterizes equifinality. The goal reached may be similar for several learners but reached in different ways. Thus, "good" and "bad" are descriptive of learning environments only on an individual learner basis. Providing a multidimensional environment, learner/systems may seek varying sources of energy and information that will reduce strains of an inappropriate learning environment.

Several researchers (Born, Gledhill, and Davis, 1972; Pascal, 1973; Dalton and Johnson, 1973) have given learners choice in method or approach to learning. Results were inconsistent. When learner/systems select or are matched to preferred environmental conditions, too much negative feedback may maintain a status quo leading to system entropy--minimal growth. When learner/system structure is determined, then an environment somewhat more complex can be provided for increased complexity of information processing, enabling the learner/system to grow and learn to cope with change.

The interdependent components of competence are depicted in Model 2. None of the parts is intended to be of primary importance in a learner/system's initial pursuit of competence. They take on relative degrees of importance based on the structure of the learner/system at a given point in time (the beginning of a specified learning experience). In designating competence as multidimensional, assessment must be made of each direction of change as well as the interrelationships among the dimensions. By labeling the dimensions, boundaries can be determined. The activity at those boundaries can be a basis for understanding the learner/system's perceived state in multidimensional competence and can provide a point of departure for assessment and prediction by the facilitator of competence development.

Application of Model 2

To use Model 2 in assessing competence development in an ecosystem framework is to assume goal-directed behavior by the learner/system. Achievement of the goal is dependent on the conditions present in the learner perceptions of the environment. Model 2 offers a perspective on

a learner/system at one point in time/space. Such a profile is a means of directing intervention toward future learner/system goals.

Figure 11 represents three learner/systems (L_1, L_2, and L_3), each of whom meets an ideal goal of multidimensional competence in both the content and process aspects of competence sought. L_1, L_2, and L_3 have been selected, hypothetically, as being of similar content and process structures in the identified pursuit of competence. Following points of assessment along the grid for each learner/system, it is obvious that each took a somewhat different course toward the goal, thus, characterizing equifinality. Because each proceeded through degrees of change toward the goal, it is evident that each was a relatively open system. Learner/system L_1 succeeded in reaching the goal with the highest degree of dispatch. The goal, X, may be placed at any point on the grid depending on learner goals.

During times of evaluation, this learner/system exhibited few tendencies toward entropy or leveling off in either content or process. Remembering Model 1, learner/system L_1 may have spent little time or energy in the self-renewal phase. On the other hand, L_1 may have spent considerable time in self-renewal immediately before pursuing this level of competence. L_1 may have acquired a large store of information or a change in environment which allowed a high degree of coping skill in the specified endeavor. The momentum of having followed an open course indicates L_1's perception of high degrees of freedom and power.

L_2 reached the designated combination of multidimensional process and content development but with different means from L_1, given the hypothetical points of assessment. L_2 dealt with a rather low level of

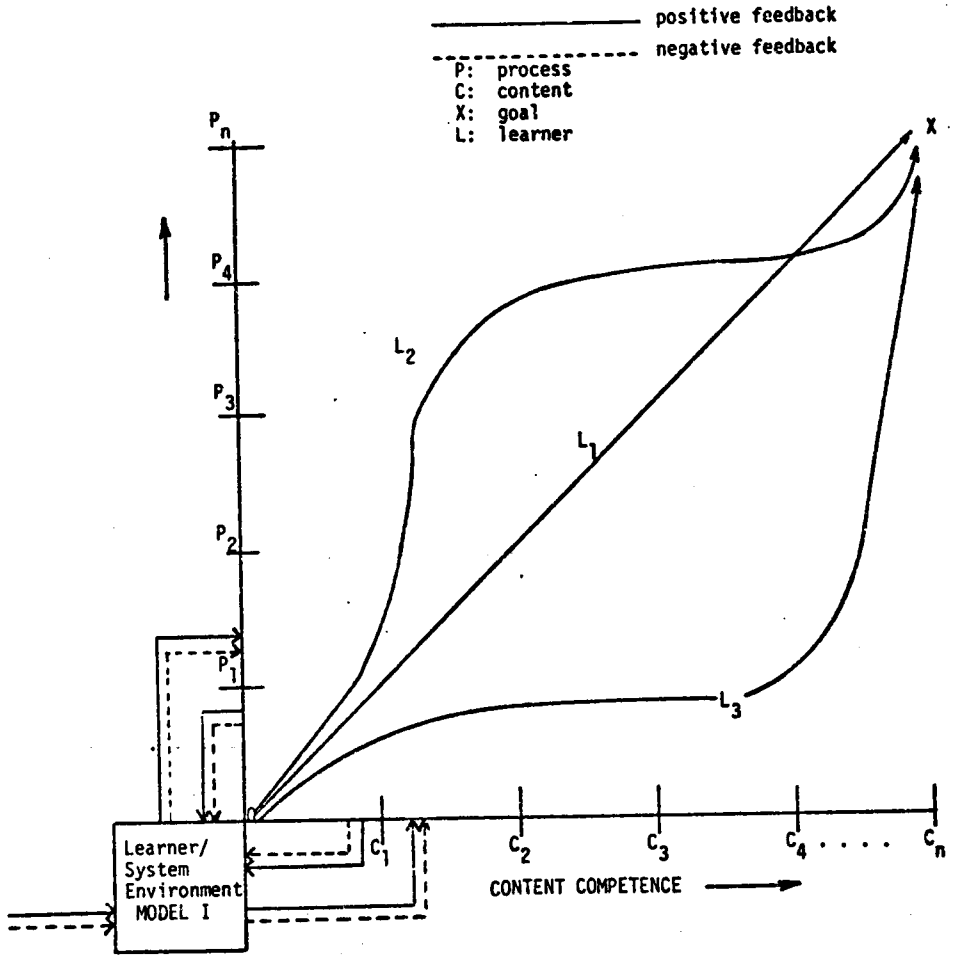


Figure 11. Process/content competence development in four hypothetical learner/systems, L_1, L_2, L_3, and L_4.

content competence through an increasingly complex degree of information-processing change.

A view of learner/system L_2 and the environment at point 0 would help to determine the possible explanations for a relatively closed attitude toward the content but an increasing level of processing skills. An obvious possibility could be the influence of the environment. Some instructors and/or school systems emphasize process over content. Open classroom schools reputedly emphasized process over content. Humanists insist on an emphasis here which is not recognized by content-oriented instructors and school systems. The fact that L_2 did achieve the designated goal suggests a learner/system cause for the direction taken. Given a second plateau from P_4C_4 emphasizing growth in content competence suggests an individual who can cope with only one thing at a time. Maintaining status quo in content during the first plateau was a source of negative feedback necessary for maintaining a steady state while growth occurred in process development. The fact that the profile is steady, not decreasing--returning to 0--suggests that homeostatic devices may have been used by the learner/system to avoid chaos. Had the growth line from P_4C_2 to P_4C_4 been wavy or directed toward lower level information processing skills as new complexities in content were realized, it could be assumed that learner/system L_2 would have to revert to more simplified processing skills with each increment in content complexity. Such an event would require a careful assessment of the content-process balance so that the reversal in information processing would not be permanent. Such an occurrence would have implications for future intervention.

Learner/system L_3 offers an opposite profile to L_2. A strong grasp of content was achieved before expansion of processing skills could be instituted. Two sources of positive feedback could have been perceived as beyond learner/system L_3's coping skills. Again, environmental systems may have influenced the learner/system's perception of greater power in content.

Four learner/systems (L_4, L_5, L_6, and L_7) which have limited competence development or none at all are illustrated in Figure 12. Learner/system L_4 has developed a high level of content competence. Development was linear because only basic processing skills were developed. The environment did not provide the stimulus for increasing information-processing skills. Many educators advocate an emphasis on content. In an ecosystem conceptualization of competence development, content is an important but not isolated factor which cannot exist alone without development of coping, adapting, and growth processes. As content changes with changing society, the learner, then, can deal with the change of information. In an ecosystem framework, one factor may be temporarily ignored, but it is affecting other factors inevitably, because the variables cannot be studied in isolation.

Learner/system L_5 offers a similar linear approach to competence development but disregarding content. This substantive factor is affecting the learner. The fact that content competence is not achieved suggests no content competence development, thus, entropy. The consequences will be lack of knowledge/content on which to base information processing. A typical example of content nongrowth is the individual who considers a degree or diploma as the ultimate in content achievement.

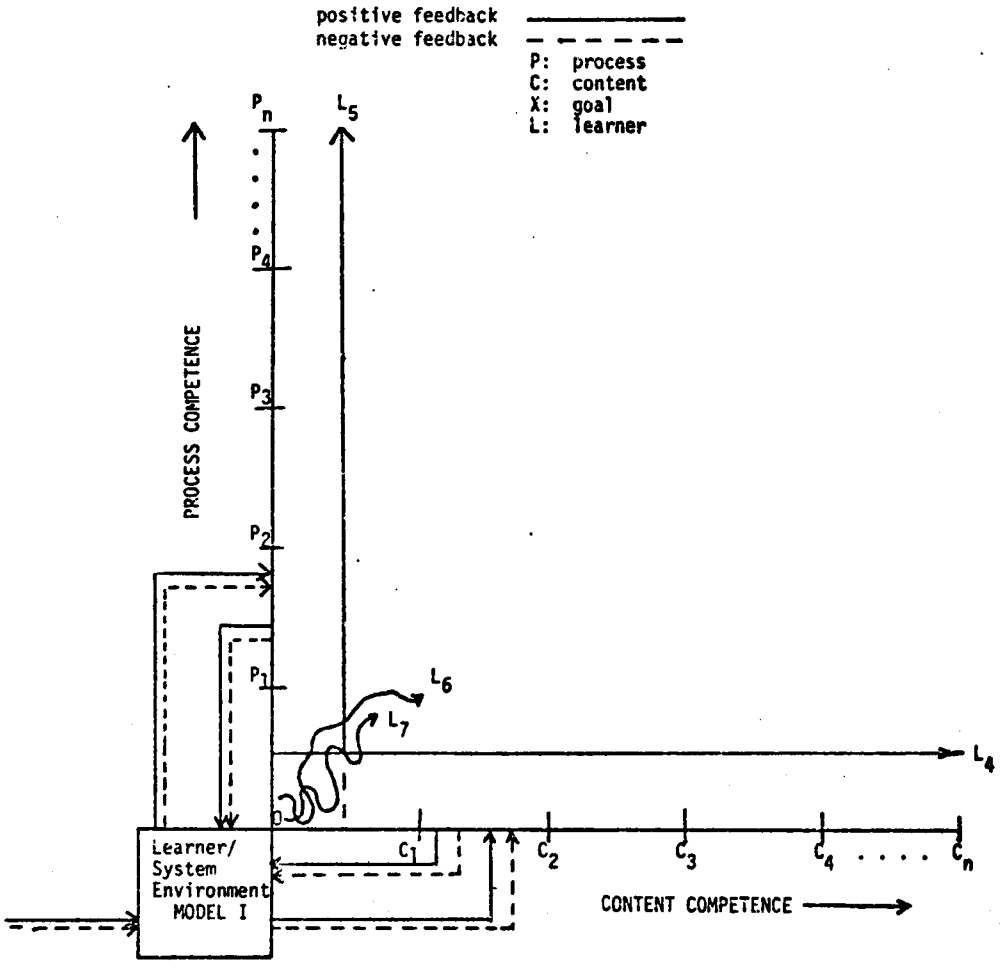


Figure 12. Process/content competence development in four hypothetical learner/systems, L_5, L_6, L_7, and L_8.

This learner/system may continue in process competence development for a while in working with people in a career. It is only a matter of time when incompetence will be visible, if the learner/system does not choose to continue learning. Lack of continued competence development in content will also affect growth in processing skills.

Learner/systems L_6 and L_7 are most limited. Neither develops competence in either content or process. L_6 relied so much on negative feedback that status quo is maintained. A small amount of progress toward the learner/system goal is direct but stops at P_1C_1. Original state was essentially maintained, which is characteristic of systems relying on negative feedback. Negative feedback maintains the system with little or no growth. Feedback which is only negative from both within the system and its environment eliminates stimulus for growth. If L_6 has a low self-concept and receives no information from the environment for development, L_6's interfaces will broaden, shutting out eventual help, and entropy is likely in this relatively closed system. Learner/system L_7 received enough positive feedback to make coping impossible. System chaos is likely to result if the situation is not perceived by the learner/system within the environment. Fluctuation may suggest random progress and regression resulting in almost no growth. The fluctuations could be a depiction of learner chaos--entropy.

Model 2 represents the increasing information-processing level and increasing content complexity and their interrelationship as competence develops. The structure of the grid is dependent upon the goal-directed competence development of the learner/system. An ideal degree of competence involves competence in simple as well as complex processing

skills depending on learner structure and goals. Part of competence is selection of processing skills and content appropriate to the situation. The more complete the grid, the broader the range of competence from which to draw. The direction or order of competence development provides a feedback mechanism for directing learner development toward competence in all areas.

The grid may vary among content areas and is likely to change as the learner/system matures. Temporal aspects of competence development will vary from learner to learner and within learners as they progress. Use of the feedback capacity by both learner and learning facilitator can insure change. The quality of interchange between the learner/system and facilitating systems in the environment will be determining factors.

CHAPTER VI

VALIDATION OF MODELS 1 AND 2

Rapid and inevitable change will continue to provide a need for understanding and improving institutions of learning. Critics of the status and effectiveness of these institutions place responsibility on both the educator and the educated. Action based on past standards and current processes cannot assure improvements (Culberton, 1974). Along with the problems, goals of learners become increasingly varied. Societal problems assume similar multiple dimensions.

The overriding objective in the development of two competence development models was to provide a holistic picture for viewing all aspects of developing process and content competence. Models 1 and 2 provide a context to be used by the learner and the individual(s) responsible for formalized instruction as a means for assessing factors operative in the competence development of specified learner/systems. Competence was designated as reflection or measure of learner/system structure at a given point in time/spaced, based on learner/system goals. Competence was selected as the phenomenon to be used as a feedback device for directing further process and/or content growth. Ecosystem theory was designated as a theoretical and conceptual base appropriate for viewing both content and process development in a holistic context, involving the interrelationships between the learner/system and environment. Home economics may be viewed as an area of study involving interdisciplinary treatment of the family in an ecosystem or the family as an

an ecosystem. Thus, principles of ecosystem theory are applied to both process and content.

Construct Validation

How valid are these models for the use proposed? The description of the approach taken to the problem clearly indicates the complex nature of what was modeled. The ecosystem theoretical framework is not commonly used in either the content or process aspects of a learning environment. Consequently, a carefully selected group of 10 judges served in giving initial face validation by completing an opinionnaire (Appendix A). The judges were selected on the basis of their having a grasp of human learning and development, ecosystem theory, and home economics in an ecological context. Nine of the 10 judges hold teaching and/or administrative positions in seven major universities in the United States and Canada. One judge is self-employed. Six judges teach in colleges of home economics or human ecology; two teach in home economics education; and one is an administrator in curriculum and instruction. The entire population of individuals competent in dealing with all three aspects is relatively small. The 10 individuals actually involved returned consent cards indicating willingness to participate.

The data obtained from the opinionnaire--Competence Development Within an Ecosystem Framework--were analyzed, one statement at a time, in order to note consensus among judges. Ratings were based on agreement or disagreement with 22 statements concerning function and purpose of the competence development models. Comments were solicited, and those received were given consideration in assessing the models. A listing of

all comments is in Appendix B. The frequency of responses for each level of statement agreement is given in Table 1.

Analysis of Data

Of the 22 statements, 9 received strongly agree or agree responses with no undecided or disagree responses. No more than three judges disagreed with any one statement. A profile from the statements receiving only strongly agree and agree reactions indicates the following support for the function and purpose of the models:

1. The learner is the central focus in competence development (statement 1).

2. The central focus of competence development is the organism as learner in the context of the near environment (statement 2).

3. The learner/system is continually exchanging energy and/or information with the environment (statement 5).

4. Within Models 1 and 2 the learner/system may be perceived as interacting with systems in the near and distal environment (statement 8).

5. The ecosystem framework for competence development provides a perspective for learner, instructor, and administrator for better preparing the learner/system to understand and cope with change (statement 11).

6. Assessment of competence development can act as feedback for directing further competence toward goals (statement 13).

7. Defining the learner as organism in an ecosystem framework allows for assessment of learner competence at all ages, levels, and aspirations (statement 14).

Table 1. Frequency Data: Opinionnaire

Statements*	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	4	6			
2	6	4			
3	3	3	1	3	
4	1	7 Model 1**	1	Model 2**	
5	7	2			
6		5	3	1	1
7		7	2		1
8	4	6			
9	6	3	1		
10	4	4	1	1	
11	5	5			
12	4	4	1	1	
13	6	4			
14	2	8			
15	2	5	2	1	
16	8	2			
17	5	3	1	1	
18	2	6	1	1	
19		3	3	3	
20	6	4			
21	7	1	1	1	
22	8	1	1		

*Statement number refers to evaluative criteria as presented in opinionnaire found in Appendix A.

**One judge agreed with statement 4 in regard to Model 1 but disagreed with the statement as it related to Model 2.

8. Competence development includes both content and process development (statement 16).

9. Home economics may be viewed as a study of the family in its ecosystem (statement 20).

One uncertain was recorded for each of three statements which otherwise received strongly agree or agree responses. They were statements 4, 9, and 22, adding the following ideas to the profile:

10. Models 1 and 2 represent a global perspective of competence development as continual change in learner toward goals (statement 4).

11. The ecosystem framework of Models 1 and 2 provides a more complete view of competence development than a linear or additive approach to learning based on content (statement 9).

12. The "whole" of competence is greater than the sum of its parts (statement 22).

The uncertainties seemed to be based in the interpretation of Model 2 as shown and described. Model 2 focuses from a narrower perspective and was seen as linear by one judge. Eight judges strongly agreed that competence development includes both content and process development (statement 16) and that the whole of competence is greater than the sum of its parts (statement 22). This support emphasizes the attitude behind designing models for holistically assessing competence development.

Two statements received as many as three disagree responses. These were statements 3 and 19. For statement 3, judges agreed that professionals in education perceive learning as multidimensional but doubted that such a uniform commitment existed among all educators. Disagreement about statement 19 centered around clarity of function of Model 2

or lack of identification of framework mentioned. Too great an emphasis on interrelationships was taken as lack of concern for viewing components of learning independently. Statement 19 must be elaborated to state how concepts of an ecosystem theoretical framework may be used for both content and process. Emphasis was made by judges about the importance of the users of the models understanding the conceptual framework. Also, the necessity of operationalizing the models was noted.

In general, comments were made concerning the use of "all" and "neutral." The relativity of system terms and the behavioral nature of competence development are not consistent with such absolute terms. Responses may have been different had these items been eliminated.

CHAPTER VII

SPECIFIC APPLICATIONS FOR COMPETENCE DEVELOPMENT MODELS

Home economics/human ecology is one area of study which has assumed an interdisciplinary philosophy in some instances. The ecological content requires a holistic perspective for viewing interrelationships. An ecosystem framework has been incorporated into some home economics/human ecology programs in order to view the content from this holistic perspective. Included in Chapter VII is an overview of the state of the scene in this field. Other areas of study have assumed a similar philosophy. Considering the preferred content area when analyzing the learner/system environment allows a more precise perspective of that learner than heretofore presented. A field of study such as home economics can be used appropriately as an example for explaining the utility of the models. In Model 1, the learner's area of study is a factor in the learner/system environment which influences competence development. In Model 2, home economics/human ecology can be used as the content area of interest on the vertical axis. With a field of study which has implemented an ecosystem theoretical framework, the unifying nature of system theory for content and process can be illustrated.

After the overview of the use of ecosystem theory in this content area, a case study is presented as a guideline for informal use of the model. The case study provides one example for application of ecosystem concepts in understanding competence development. Textiles and clothing was chosen for focus because of the writer's interest in that field of study.

Competence Development in Home Economics with Special Reference to Textiles and Clothing

The Association of Administrators of Home Economics (1970) stated the following among the goals for research in home economics: "Improve consumer competence and family resource use" (p. 42). The basis for including this goal is multifold. The consumer in our society is forced to make decisions without adequate valid information. Legal protection alone will not prepare the consumer to maximize resources in working toward goals. Consequently, a need is seen for provision of information for choice making for the consumer to learner to discrimate among information sources and quality. N. Harries (1971) stated that "consumer participation involves motivation and education, which speaks to the educative role of home economists" (p. 26). From a series of seminars involving industry and university representatives, Harries concluded that "industry perceives the educative role of the home economist as a most important function for making the consumer responsible for his or her actions" (p. 26).

The consumer of a curriculum geared to the interdisciplinary study of the family as an ecosystem and/or in an ecosystem is the individual who will function as purveyor of both what has been learned and how it has been learned (content and process). A home economics program, then, must reflect increased multidimensional competence in process as well as content. Not only must the student of such a program act as filter of content but also as a facilitator of self-renewal, adaptation, and growth--multidimensional competence development--within the consumers who receive the content and process aspect of the home economist's expertise.

The concept of equifinality must be recognized in several aspects of an interdisciplinary approach to home economics. The learner/systems will vary in means for reaching similar ends because differing conceptual levels, aspirations, and history; instructors will vary in those and other factors while still aiming toward similar goals for learners; and the base disciplines differ obviously but remain an influence in content competence development. A profile of instructor and learner on Model 2 could assist in matching appropriate learner, instructor, content, and career. Perceptions based on the ecosystem conceptualization of competence development may assist in diagnosing for effective intervention of content and environment. Rather than using typical solutions from typical sources, an analysis based on the two models may assist in selection of an interdisciplinary approach based not only on integrating disciplines of content learning, but also on integrating input from instructors with educational philosophies based on varying learning theories. An interdisciplinary effort of unique membership would be required to monitor the many emphases proposed for effectively integrated competence development. Expertise for such a faculty would be multidimensional from both content and process bases, with each factor recognized in assessing intervention for increasing competence development in a specified learner. Further, with a process and content profile, the graduate may be placed in a career based on more than content expertise.

The basis for using an ecosystem framework in home economics involves recognition of this area of study as a study of family problems from numerous but interrelating perspectives. And, as colleges of home

economics recognize the interdisciplinary nature of their pursuits, they are recognizing the necessity of providing an integrative framework to students who will gear their interests to families in the context of their near environment. Multidimensional competence must be sought by these students, with the provision of learning and research environments conducive to their endeavors.

Hook and Paolucci (1970) were among the first to propose an ecosystem framework for home economics. To deal with quality of human life, consideration must be given to the interdependence of people and their environments. Hook and Paolucci were influenced initially by Duncan's POET model, where population, organization, environment, and technology represent the interacting components in the ecosystem. Recognizing their "sphere of concern" as the family, Hook and Paolucci adapted Duncan's model to the "family and that part of the near environment that impinges directly upon the family and is subject to manipulation by the family" (1970, p. 316). Vaines (1974) proposed an ecosystem framework for home economics to facilitate the classification of the major goals of the profession. She saw the need for presenting the interaction of a person as an organism in relationship with the environment, in a way more dynamic than the commonly used linear framework which depicts direct cause-effect relationship in a static manner.

Some specific applications of ecosystem concepts have been made to areas of home economics. Burk (1970) demonstrated the interrelationship of food economic behavior to the family, using system terms. Steidl (1969) showed the ecological implications of family managerial behavior. N. Harries (1972) studied the information-processing skills of

undergraduate students studying textiles and recommended that an ecological research approach be used to bring together the interaction of organism and environment in studying the learning process.

The Association of Administrators of Home Economics (1970) suggested that a global approach to research problems should be assumed. They delineated broad research goals based on an ecosystem framework comprised of biophysical, psycho-social, and technological aspects of the family and its near environment. They stressed the importance of focusing on the interfaces between these areas as well as the separate areas.

Multidimensional Competence in Textiles

Textiles is a vital component of the near environment. The relevance of this content area to families is realized only as it is viewed in interaction with other components of family environment. Textiles is one aspect of base disciplines of history, art, chemistry, physics, and others; so, it must be looked at in this interdisciplinary context. Inherent complexity and required integration of disciplines suggests the appropriateness of an ecosystem framework for viewing developing competence in textiles. Working with the complexity of interdisciplinary content implies uniqueness in learning process development. A linear framework of competence development in textiles does not provide for the integration of disciplines or the complex learning processes within the learners and among learners interested in different aspects of this interdisciplinary field.

Undergraduate curriculum must be designed to reflect the research and educative roles of the textile profession. According to R. Johnson

(1974), the home economist has been used in the "handmaiden (of industry) role to shape consumer reactions" (p. 31). Johnson reported that there appears to have been voluntary exploitation of home economists because consumer preference research has become a standard activity in academic departments of textiles and clothing. He opposed the "supershoppership" image often conveyed in university textiles and clothing programs. N. Harries (1971) stated that the home economists should "be equipped by practice, education, and certainly commitment to coordinate the application of many specialized disciplines toward goals which reflect the needs of the consumer" (p. 29).

Participants in a national workshop sponsored by the American Home Economics Association (1974) agreed that all home economists are involved in the teaching/learning process in their professional roles in business, extension, health and welfare, research, and other areas of family and community service. Although the workshop involved selection of competencies for professional education in home economics, the workshop participants delineated the following assumptions, applicable to all educators in the field:

> 1. Competence in the educative process is needed by all professional home economists.
> 2. Home economics graduates are employing the educative processes in nonschool as well as school settings.
> 3. The development of programs to provide for the achievement of competencies will vary from institution to institution according to philosophy and resources available.
> 4. Competencies serve as a basis for developing instructional strategies.
> 5. The pattern of attainment of competencies by individuals must be adaptable to varying requirements in employment.
> 6. The primary arena for the development of competencies for the home economist is in the field.
> 7. Research will be needed to validate the criteria for measuring competency attainment, but this should not inhibit the use of competencies as a basis for developing professional programs. (p. 4)

These administrators' definition of competence encompassed attitude, behavior, skill, and understanding demonstrated by a participant at a specific level of performance.

Thomas D. Efland (1964), Associate Dean and Director of Research, School of Industrial Management and Textile Science, Clemson College, recognized the need for interdisciplinary as well as an on-going process of textile learning. We can no longer think of preparing a student for a specific position but rather of a future (Efland, 1964). He noted the need for development of a foundation upon which the learner can grow via experience and self-education. Reading, critical observation, and thinking are imperative as part of education from this view of educational process.

Summary

Models 1 and 2 are designed to provide a conceptual framework for viewing the integrated development of process and content competence. The intention is to illustrate competence as multidimensional, developing in complexity, and continuous. Thus, the conceptual framework may be used as a depiction of increasing cognitive complexities within the learner as he/she is subjected to increasingly complex learning environments. The content complexity factor is similar in developing dimensions and complexity, and content and process cannot be isolated as learner competence increases.

For the learner to be able to deal with increasingly complex information from a complex environment of present and future time, information-rich environments must be provided in education. A variety

of types of information must be experienced. Decision making with realization of future consequences of those decisions has been seen as a necessary end to increasing process competence (N. Harries, 1974).

Dealing with problems from an interdisciplinary perspective has been viewed as necessary if we are to come to grips with individual and societal situations (Jantsch, 1972; Taschdjian, 1972). Interdisciplinarity requires multidimensional content and processing competence and their integration. Home economics is one example of a field of learning which has assumed a responsibility for human studies and, therefore, requires an interdisciplinary thrust. This responsibility entails curriculum, instruction, theory, and research. In addition, it requires responsibility to understanding learners who pursue this area of study and to individuals who consume or receive the information from graduates. Is the learner in the school setting provided with a learning environment conducive to this responsibility?

Case Study

In addition to being used as a theoretical framework for designing empirical studies, the models may be used on an informal level in assessing competence development. A case study is included as an example of how this process may be implemented. Both competence development models based on ecosystem theory will be used. For this case study, one student has been designated as the system of interest. The system may vary according to interests of the observer. A profile will be drawn of a hypothetical home economics student with a major in textiles and clothing. The case study learner/system is developing competence as an

undergraduate student at a major university.

The learner/system structure may be described as relatively closed upon entering the university. This structure represents an accumulation of experiences from previous learning environments as well as from her personal environment.

Before entering the university, this student lived at home and attended traditional elementary and high schools where content was stressed and little variety was offered in learning environment. From the experience the learner/system developed competence in subject matter of A quality by the school's standards. A consistent traditional teacher-directed environment provided a homeostatic approach to maintaining a steady state in this learner/system. She adjusted her DSE functions to fit the changes in her environment as she progressed through school. Because of this environment, she interfaced with few other systems in her environment and depended on the negative feedback of the established teaching method to maintain her steady state. She received her goal of an A average for college entry with relative ease. Her learning was linear and additive because of the unidimensional environment. In fact, positive feedback other than the expected incremental difficulty in content was disturbing (entropic) to the student.

Her personal profile included biophysical input of diabetes with which she had learned to cope at an early age. Psycho-social input included family values encouraging a professional career which would insure a job upon graduation from college. Creativity or learner/system-initiated endeavors were not encouraged. Because of the security of

family and school-directed steady state, this learner/system perceived few degrees of freedom. Thus, she did not seek interfaces with other systems in her environment or take advantage of her own potential individual influence on the environment (equifinality). Additional negative feedback was received from her suprasystem in that her goals and internal map were highly supported. Her choice of a nursing career reinforced all negative feedback, including a desire to understand her own physical state. These sources of influence are depicted in Model 1.

A year in nurses training provided a homeostatic, environmentally directed experience of the nature of previous school experience. Early in that year she interfaced with a new friend who worked as a buyer at a major department store. Awareness of the job and the clothes worn by this friend provided some positive feedback which this learner/system processed. A short period of self-renewal allowed for an adjustment in values and goals (selector function) and an altered relationship with her parents. She decided to initiate some change in her environment. She entered a fashion merchandising program which was to provide considerable positive feedback. And, she established interfaces with people who provided a new dimension in content. She was becoming an increasingly open system.

Moving to Model 2, we can informally assess the learner/system competence development structure. Remembering the dynamic quality intended for each model, it must be noted that the learner/system's competence development is continually fluctuating. However, at the point in time/space when she entered the fashion merchandising program, an informal assessment may be made by an individual who is knowledgeable

in process and content competence and can assess the dimensions acquired by this hypothetical learner/system up to this point.

The learner/system seems to have developed considerable competence in several content areas, but with minimum process/content development, she has difficulty applying and integrating these concepts. Alternative learning environments necessary for continued development of multi-dimensional competence were sources of positive feedback. False absolutes in content and process had functioned as sources of negative feedback, and her minimum coping skills indicated potential difficulty in dealing with the constantly changing world of a fashion buyer. Her competence structure on Model 2 could be seen as approximately P_1C_3.

Manifestation of the entropic tendencies derived from new content dimensions were seen in lower grades. Large classes of generally required subjects taught in the manner with which she was familiar supplied the source of negative feedback needed for reestablishing a steady state. Her goal became that of graduating with honors. This was a positively reinforced goal from earlier times.

In order to reach this goal, she was required to complete successfully two independent study courses. The first course reinforced her confidence because of the structure and philosophy of the facilitator in that course. The learning facilitator goals included his own professional growth at the expense of providing an environment for the learner/system which would prepare her for increase in complexity of process and content competence development. The learner/system received an A for independent but undirected work. The change in her detector and selector functions and her perceived degrees of freedom were actually dysfunctional. The

second independent study course was a source of too much positive feedback and entropic tendencies resulted.

The learning facilitator of the second course preferred a strong and consistent interface with the learner/system and provided increments of process and content complexity. The learner/system perceived little negative feedback, a boundary with which she had difficulty coping, and she had difficulty maintaining steady state physically, psychologically, and sociologically. She had difficulty with her physical health, with her own self-esteem, and with interrelationships with friends and colleagues.

The learning facilitator had to intervene upon perception of her entropic state. Self-renewal was required. A more familiar process was established in order to provide negative feedback necessary for reestablishing a steady state but still allow content competence development. In order to continue process/content competence at a slower pace and continually integrate content and process, the learning facilitator provided an environment for actually learning <u>about</u> the process. One-to-one discussions concerning these multidimensional goals provided the feedback necessary for the learner/system to return to an independent approach and meet the goal she had set for herself. Thus, the open learner/system continued to increase multidimensional competence henceforth.

CHAPTER VIII

IMPLICATIONS AND RECOMMENDATIONS FOR FURTHER STUDY

The design of two competence development models was a first step in analyzing and mapping the competence development process in a holistic perspective. The models were designed and interpreted from an ecosystem theoretical framework. The environmental impingements upon the learner/system who is developing competence and the process components through which that learner proceeds toward a goal are depicted in Model 1. The interrelationship and increasing complexity between the process and content aspects of developing competence are emphasized in Model 2.

A series of interrelated assumptions provide a basis for testing the models from several levels. Assumptions are that a learner/system is bounded in time/space, with interchange of energy among interfacing systems and subsystems. Relationships assumed in general system theory were assumed in competence development based on an ecosystem framework. The concepts were defined and interpreted in Chapter III.

Specific applications were presented in Chapter VII of an ecosystem theoretical framework for content and process competence development. These examples can be used as bases for understanding implications and recommendations for further study which are presented in this concluding chapter. First, a set of propositions included as a beginning for validating the theoretical competence development models developed within this paper. Hypotheses may be drawn from these propositions for further study. Then, suggestions are offered for further use of the

opinionnaire. Finally, suggestions are given for implementation of these competence development models in current learning environments.

Propositions for Studying the Learner in/as an Ecosystem

In order to analyze competence development empirically, based on the theoretical framework set forth in this paper, it must be assumed that the structural and process characteristics of the learner/system and subsystems can be measured. J. G. Miller (1965c) stated in outlining cross-level hypotheses for living systems that such quantification is possible. Some of the performance variables which Miller reported as measurable include equilibratory ranges, variances, rates of transmission, lags, error rates, omission rates, and energy costs and efficiencies. He suggested the study of input-output relationships, variables maintained in equilibrium by the total system, adjustment processes, feedback characteristics, growth and decay characteristics, and degree of integration or segration (J. G. Miller, 1965c).

Identification of structural variations among learner/systems will help in understanding process variations among learner/systems. This understanding can be broadened by placing the learner/system in a similarly well-defined (understood) environment. That is, the interfacing subsystems both human and nonhuman, which are linked functionally to the learner/system must be characterized to see complete synergistic effects on the learner/system. Each of the above analyses must be defined in light of learner/system goals and goals of interfacing systems. Otherwise, generalizations drawn will have relatively limited application.

Proposition 1. The characteristic openness of subsystems or cooperating systems will influence the dynamic qualities of the learner/system. For example, if the learning facilitator is a relatively closed system, the learner/system is less likely to become more open during interaction with that facilitator. This will be influenced by the initial openness of the systems involved or the systems' initial ability to process information from the environment. If the learner/system and learning facilitator are interfacing with opposing (or different) subsystems which can possibly weaken their relationship with each other, little information will be processed, thus, minimizing the momentum toward increasingly complex competence development. Implications involving perceived degrees of freedom may be drawn from this proposition, too.

Krantz' (1975) proposal of multiple-model programming, whereby teachers and students are matched according to student needs, teacher personality, and teaching philosophy and program goals, could be an initial step in providing mutual boundaries for learner/system and facilitator. Negative feedback is provided. If too much negative feedback persists in discounting positive feedback via program diversity, little learner/system multidimensional competence development may occur (Cunningham, 1975). Hunt's (1975) conceptual-level matching models seem to have similar assets and liabilities.

Proposition 2. Learner/systems developing competence in a formalized learning environment require a certain degree of negative feedback in order to maintain a steady state with the environment. Too

much positive feedback may lead to system chaos.

As related in Proposition 1, a danger exists in not balancing the required negative feedback with some growth-inducing positive feedback. Educators will need to find means for measuring this balance. In the realm of competence development, this proposition may be viewed and measured and then mapped on Model 2. Gilley and French (1976), Dalton and Johnson (1975), and Pascal (1973) are among the educators who have reported learner preference for instructional modes, as measured by increased scores on tests. A danger exists that emphasizing the preferred method will minimize multidimensional competence development (Cunningham, 1975; Verzaro, 1975). In order for a student competence development profile on Model 2 to exhibit growth in both process and content competence, increase in each dimension must be shown by increase in cognitive complexity. Such development presupposes a relatively open system interfacing with many subsystems, hence, experiencing a wide variety of environmental input.

Davis, Marzocco, and Denny (1970) and Baker, Bakshis, and Tolone (1974) were among researchers finding either no performance difference among methods or learners choosing the traditional method. These students may be relatively closed systems relying heavily on negative feedback to maintain a steady state rather than seeking positive feedback via new or varied experiences. Perhaps externally determined goals such as criterion levels, predetermined competencies, or behavioral objectives are effective initially and are a source of negative feedback, but they do not serve multidimensional competence development as a dynamic and continuing process. Low-conceptual-level learners (Hunt, 1975) may tend

to seek such security, but educators have a responsibility to offer measured amounts of variety appropriate to learner/system structure and goals.

Proposition 3. The greater the restrictions placed on learner/system boundaries from the environment or in learner perceptions of boundaries, the greater the restrictions on multidimensional competence development. Homeostatic control of steady state is controlled environmentally, thus, minimizing learner/systems' control of their own competence development. Perception of low degrees of freedom by learner/systems or actual low degrees of freedom may be influential in maintaining carefully defined and limiting boundaries. Relatively inflexible and impermeable boundaries have limiting effects similar to those noted in Proposition 2. That is, the boundaries must be permeable to the input of negative and positive feedback. The learner/system must perceive the availability or appropriateness of degrees of freedom necessary for coping with change.

Proposition 4. A learner/system perceiving stress in a learning environment will seek negative feedback to alleviate that stress. Such a learner/system is relatively closed. One source of negative feedback may be familiar educational settings. A learner/system coping with too much positive feedback at any level of cognitive complexity will reach an entropic state.

Schroder, Driver, and Streufert (1967) proposed an inverted U-curve whereby the learner performance would take a downward turn when an

optimum degree of environmental complexity was reached. That optimum degree will vary according to the initial learner structure.

As Model 2 represents, however, the learner must begin competence development at a level appropriate to learner structure at the time/space when competence development commences. And, this point will vary among learner/systems.

Proposition 5. In order to assess competence and direct further development, the learner/system must be viewed as a whole. Learner/system competence and goals may be viewed as integrating biophysical, psycho-social, and aesthetic-environmental aspects of that individual. Bloom (1956), Krathwahl et al. (1964), and Gronlund (1970) are among educators who have expressed the need to write objectives in several domains of learning. Macdonald et al. (1973) is one critic of learning so structured as to segregate domains of learning or ignore affective aspects.

Proposition 6. Two-way channels which permit feedback improve competence development by minimizing distortion in the communication between systems. Two relatively open systems are more likely to promote mutual growth via increasingly complex process and content competence than will two relatively closed systems.

Proposition 7. Learner/systems which are relatively open systems reach similar goals by following channels unique to their history and structure. This characterizes equifinality. Model 1 represents the variables which influence the differences among system structures and

processes and Model 2 can be used to map the development. The learner/system generates new information and manipulates the environment toward a goal.

Proposition 8. A relatively open learner/system, through adaptation or adjustment to change, develops increasingly complex and multi-dimensional competence. Piaget's (cited in Ginsburg and Opper, 1969) developmental theory followed the idea of progression from simple to more complex levels of development. The process is on-going because the learner/system and the environment are continually changing.

Proposition 9. More direct information flow will occur within a learner/system boundary than from the suprasystem. More distortion occurs further away from than closer to the information source.

Proposition 10. As learner/systems achieve measurable degrees of competence, their goals and insights may change. As a relatively entropic influence on learner/systems, the processing of this positive feedback may require self-assessment or self-renewal. This part of the competence development process is shown in Model 1.

Recommended Refinements for Further Validation

After the initial step in validating the models as presented in Chapter VI, several changes in explanation could provide clearer basis for further validation. First, Model 2 could be presented as a more dynamic model than perceived by these judges who participated in the initial survey. Examples could be given of its use. Though the grid

structure was meant to emphasize periodic assessment of process and content competence, without further explanation it seems to suggest set incremental points of assessment, minimizing two major objectives of the model--adaptability to the individual learner's competence at any given point in time/space and support for the idea of learners reaching similar goals through different means, thus, characterizing equifinality.

Before implementing the models, changes and refinements must be made. The input of the 10 judges is a valuable first step. The input of these judges will be implemented before introducing the models to other educational professionals. After incorporating feedback from these judges who are familiar with most concepts used, a carefully designed presentation must be prepared for educators less familiar with the concepts. Then, implementation of this second-stage feedback can be used for refinement of models which may function effectively for any user.

Suggestions for Implementation of Competence Development Models in Current Learning Environments

Ideas are included below which may answer questions and guide in the use and function of the models within the constraints of a currently operating learning environment. Suggestions are intended for implementation of the models from several vantage points.

1. Dominant constraints expressed by many educators are lack of time, excessive size of classes, and an over abundance of paperwork. How can these models be used under these common limitations? Identify

learners as subsystems within a classroom of learners rather than studying each learner individually. Identify the group as the system of interest. Study the interrelationships among learners of different competence structures according to ecosystem principles presented.

2. Without the existence of quantifiable measurement, how can the models be used? Analyze adaptation processes of learner/systems in times of growth, plateau, or stress. A reliable human rater system could be developed for use in such an analysis. Also, an informal process such as the case study approach presented in Chapter VII may be helpful.

3. How may consistency be achieved in use of the models? How can classroom teachers achieve any competence in using these ideas? Conduct workshops to prepare instructors and/or administrators for using the models within their current school environment.

4. Instructor competence is similar in importance to learner competence. How can this be evaluated? Develop an instrument for analyzing instructor performance in assessing individual learners based on learning theories and empirical findings which apply to the structure and time/space of the learner(s) of immediate interest. Hunter (1976) has focused on the process of teaching in a schemata within which assumptions about teaching can be organized and relationships in teaching and learning can be processed.

5. How can an instructor develop an awareness of the processes depicted in the models on an informal basis which can be integrated into daily instructional tasks? Develop questions which may be asked by new instructors which provide guidance for use of various aspects of the models.

6. How can planning and decision making be facilitated by these models? Immegart and Pilecki (1973) provide case studies, examples, and explanations concerning the practical use of system theory in educational administration. A general example to consider is assessment of relative time, cost, and benefit of several options involving a system function, followed by selection of the optimum solution from systematic relational thought.

7. How can an instructor evaluate increasingly complex competence development? Write examinations of increasing complexity. Questions should seek depth, breadth, increased rate of information change, evidence of internally generated information for adaptive purposes, and future orientation.

8. Provide learning environments which allow for development of the process competence suggested in idea 7.

9. Where does one begin? What has been done to date in achieving objectives outlined from this theoretical framework? Read a variety of sources which may provide stimuli for implementing competence development based on an ecosystem theoretical framework. The bibliography of this paper includes several sources which may be helpful, such as Hunt and Sullivan (1974); Immegart and Pilecki (1973); and Schroder, Karlins, and Phares (1973).

The development and initial validation of two competence development models based on an ecosystem framework are a beginning for dealing with the complexities and changes in formalized education. Continued study, use, and validation of the models is required in order to assure

the value of such thinking. The speed and inevitability of individual and societal change are well documented. Perhaps these models provide vehicles for helping to deal with that change.

BIBLIOGRAPHY

BIBLIOGRAPHY

Adams, R. E. Building competency models. One approach to occupational analysis. Canadian Vocational Journal, 1974, 10, 36-54.

Apple, M. Behaviorism and conservatism: The educational views in four of the "systems" models of teacher education. In B. Joyce & M. Weil (Eds.), Perspectives for Reform in Teacher Education. Englewood Cliffs: Prentice-Hall, 1972.

_____. The adequacy of systems management procedures in education and alternatives. In A. H. Yee (Ed.), Perspectives on Management Systems Approaches in Education. Englewood Cliffs: Educational Technology Publications, 1973.

Ashby, W. R. Analysis of the system to be modeled. In R. M. Stogdill (Ed.), The Process of Model-Building in the Behavioral Sciences. Columbus: Ohio State University Press, 1970.

_____. Variety, constraint and the law of requisite variety. In W. Buckley (Ed.), Modern Systems Research for the Behavioral Scientist. Chicago: Aldine, 1968.

Baker, P. J., Bakshis, R., & Tolone, W. Diversified learning opportunities: A response to the problem of mass education. Research in Higher Education, 1974, 2, 251-263.

Berger, G. Introduction. In Interdisciplinarity Problems of Teaching and Research in Universities. Centre for Educational Research and Innovation. Organization for Economic Co-operation and Development, 1972, pp. 23-26.

Berrien, F. K. General and Social Systems. New Jersey: Rutgers University Press, 1968.

Bertalanffy, L. General System Theory. New York: Braziller, 1968a.

_____. General system theory--A critical review. In W. Buckley (Ed.), Modern Systems Research for the Behavioral Scientist. Chicago: Aldine, 1968b.

Bertrand, A. L. Social Organization. A General Systems and Role Theory Perspective. Philadelphia: F. A. Davis, 1972.

Block, J. H. A description and comparison of Bloom's learning for mastery strategy and Keller's personalized system of instruction. In J. H. Block (Ed.), Schools, Society and Mastery Learning. New York: Holt, Rinehart and Winston, 1974.

Bloom, B. S. An introduction to mastery learning theory. In J. H. Block (Ed.), Schools, Society and Mastery Learning. New York: Holt, Rinehart and Winston, 1974.

Bloom, B. S. (Ed.). Taxonomy of Educational Objectives: Cognitive Domain. New York: David McKay, 1956.

Born, D. G., Gledhill, S. M., & Davis, M. L. Examination performance in lecture-discussion and personalized instruction courses. Journal of Applied Behavior Analysis, 1972, 5, 33-43.

Boulding, K. E. Toward a general theory of growth. Canadian Journal of Economics and Political Science, 1953, 19, 326-340.

Bruner, J. S. Needed: A theory of instruction. In R. T. Hyman (Ed.), Contemporary Thought on Teaching. Englewood Cliffs: Prentice-Hall, 1971.

Bruner, J. S., Goodnow, J. J., & Austin, G. A. A Study of Thinking. New York: John Wiley and Sons, 1956.

Buckley, W. Society as a complex adaptive system. In W. Buckley (Ed.), Modern Systems Research for the Behavioral Scientist. Chicago: Aldine, 1968.

_____. Sociology and Modern Systems Theory. Englewood Cliffs: Prentice-Hall, 1967.

Burk, M. C. Food economic behavior in systems terms. Journal of Home Economics, 1970, 62, 319-326.

Burns, R. W. Achievement testing in competency-based education. In R. W. Burns & J. L. Klingstedt (Eds.), Competency-Based Education. An Introduction. Englewood Cliffs: Educational Technology Publications, 1973a.

_____. Behavioral objectives for competency-based education. In R. W. Burns & J. L. Klingstedt (Eds.), Competency-Based Education. An Introduction. Englewood Cliffs: Educational Technology Publications, 1973b.

Carroll, J. B. A model of school learning. In M. Mohan & R. E. Hull (Eds.), Individualized Instruction and Learning. Chicago: Nelson-Hall, 1974.

_____. Instructional methods and individual differences. In R. Gagne (Ed.), Learning and Individual Differences. Columbus: Charles E. Merrill, 1967.

Chin, R. The utility of system models and development models for practitioners. In W. Bennis, K. D. Benne, & L. R. Chin (Eds.), The Planning of Change. New York: Holt, Rinehart and Winston, 1962, pp. 201-214.

Competency-Based Professional Education in Home Economics. Selected Competencies and Criteria. Washington, D.C.: American Home Economics Association, 1974.

Cook, F. S., Director. A Model for a Competency-Based Instructional System. Detroit: Department of Vocational and Applied Arts Education, Wayne State University College of Education, 1973.

Coop, R. H., & Sigel, I. E. Cognitive style: Implications for learning and instruction. Psychology in the Schools, 1971, 8, 152-161.

Cremin, L. A. Public Education. New York: Basic Books, 1976.

Cronbach, L. J. How can instruction be adapted to individual differences? In R. M. Gagne (Ed.), Learning and Individual Differences. Columbus: Charles E. Merrill, 1967.

Culbertson, J. Forward. In S. P. Hencley & J. R. Yates (Eds.), Futurism in Education. Methodologies. Berkeley: McCutchan, 1974.

Cunningham, J. L., & Verzaro, M. Multiple-model programming: Mandated? manageable? myopic? 1976 AERA Annual Meeting Abstracts of Papers and Symposia, 1973, pp. 202; 223-9485; 124-125 (Summary).

Dalton, J. A., & Johnson, T. E. Evaluation of alternative instructional programs for graduate education. The Journal of Experimental Education, 1975, 43, 84-89.

Davis, R. G., Marzocco, F. N., & Denny, M. R. Interaction of individual differences with modes of presenting programmed instruction. Journal of Educational Psychology, 1970, 61, 198-204.

Dewey, J. Democracy in Education. New York: Free Press, 1944.

_____. How We Think. A Restatement of the Relationship of Reflective Thinking to the Educative Process. Chicago: Gateway, 1971.

Dodl, N. R. Program evaluation and student assessment. In D. W. Anderson, J. M. Cooper, & M. V. DeVault (Eds.), Competency-Based Teacher Education. Berkeley: McCutchan, 1973, pp. 109-123.

Doll, W. E. A methodology of experiences: An alternative of behavioral objectives. Educational Theory, 1972, 22, 309-324.

Doyal, L. Interdisciplinary studies in higher education. Universities Quarterly, 1974, 28, 470-487.

Duchastel, P. C., & Merrill, P. F. The effects of behavioral objectives on learning: A review of empirical studies. Review of Educational Research, 1973, 43, 53-69.

Dyer, H. S. The discovery and development of educational goals. Proceedings of the 1966 Invitational Conference of Testing Problems. Princeton: Educational Testing Service, 1967.

Ebel, R. L. Some comments by R. L. Ebel. School Review, 1967, 75, 261-266.

Efland, T. D. Clemson College's changing textile education program. Modern Textiles Magazine, 1964, 45, 40-41.

Eisner, E. W. Educational objectives. Help or hindrance? The School Review, 1967, 75, 250-260.

Emery, F. E., & Trist, E. L. Socio-technical systems. In F. E. Emery (Ed.), Systems Thinking. Baltimore: Penguin, 1971.

Evans, F. C. Ecosystem as the basic unit in ecology. Science, 1956, 123, 1127-1128.

Frymier, J. R. A School for Tomorrow. Berkeley: McCutchan, 1973.

Frymier, J. R., Wilhour, J., & Rasp, A. Curriculum. In J. R. Frymier (Ed.), A School for Tomorrow. Berkeley: McCutchan, 1973.

Gaffney, D. E. The Development and Evaluation of Programmed Instructional Components for Selected Concepts in a College Textiles Course (Doctoral dissertation, Oklahoma State University). 1971 (University Microfilms No. 72-21867).

Gagne, R. M. The Conditions of Learning (2nd ed.). New York: Holt, Rinehart and Winston, 1970.

Gardner, J. W. Self-Renewal. New York: Harper and Row, 1964.

Gilley, D. V., & French, R. L. Personal Learning Styles: Exploring the Individual's Sensory Input Processes. Presented at the meeting of American Educational Research Association, San Francisco, 1976.

Ginsburg, H., & Opper, S. Piaget's Theory of Intellectual Development. An Introduction. Englewood Cliffs: Prentice-Hall, 1969.

Ginther, J. R. A model for strategies of instruction. In I. Westbury & A. A. Bellack (Eds.), Research into Classroom Processes. Recent Developments and Next Steps. New York: Teachers College Press, 1971.

Glaser, R. Educational psychology and education. American Psychologist, 1973, pp. 557-566.

_____. Individuals and learning: The new aptitudes. Educational Researcher, 1972, pp. 5-13.

Glossary of terms--Competency-based teacher education. Teacher Education Development Service. Albany: State University of New York, 1974.

Groff, P. Some criticisms of mastery learning. Today's Education, 1974, 63, 88-91.

Gronlund, N. E. Stating Behavioral Objectives for Classroom Instruction. New York: Macmillan, 1970.

Gross, L. J. A new model for investigating the effects of teacher behavior. The Journal of Experimental Education, 1974, 43, 24-27.

Hall, A. D., & Fagan, R. E. Definition of system. In W. Buckley (Ed.), Modern Systems Research for the Behavioral Scientist. Chicago: Aldine, 1968.

Hall, G. E., & Jones, H. L. Competency-Based Education: A Process for the Improvement of Education. Englewood Cliffs: Prentice-Hall, 1976.

Hall, V. C., & Russell, W. J. C. Multitrait-multimethod analysis of conceptual tempo. Journal of Educational Psychology, 1974, 66, 932-939.

Harries, N. An active role for home economists in consumer affairs. Journal of Home Economics, 1971, 63, 24-29.

_____. The Effect of a Programmed Course of Instruction on the Development of Information-Processing Competence and Decision-Making Styles. Unpublished doctoral dissertation, Michigan State University, 1972.

Harries, T. E. Human Information Processing, Locus of Perceived Control, and Intrinsic-Extrinsic Motivation as Related to Success and Attitude in a Programmed Course of Instruction (Doctoral dissertation, Michigan State University). 1973 (University Microfilms No. 73-05392).

Harvey, O. J., Hunt, D. E., & Schroder, H. N. Conceptual Systems and Personality Organization. New York: John Wiley and Sons, 1961.

Heslin, R., & Blake, B. Performance as a function of payment, commitment, and task interest. Psychonomic Science, 1969, 15, 323-324.

Hook, N. C., & Paloucci, B. The family as an ecosystem. Journal of Home Economics, 1970, 62, 315-318.

Howsam, R. B., & Houston, W. R. Change and challenge. In R. B. Howsam & W. R. Houston (Eds.), Competency-Based Teacher Education. Chicago: Science Research Associates, 1972, pp. 1-16.

Huck, S. W., & Long, J. D. The effect of behavioral objectives on student achievement. The Journal of Experimental Education, 1973, 42, 40-41.

Hunt, D. E. Person-environment interaction: A challenge found wanting before it was tried. Review of Educational Research, 1975, 45, 209-230.

Hunt, D. E., & Sullivan, E. V. Between Psychology and Education. Hinsdale: Dryden Press, 1974.

Hunter, M. Teacher competency: Problem theory, and practice. Theory Into Practice, 1976, 15, 162-171.

Immegart, G. L., & Pilecki, F. J. An Introduction to Systems for the Educational Administrator. Reading: Addison-Wesley, 1973.

Interdisciplinarity. Problems of Teaching and Research in Universities. Centre for Educational Research and Innovation. Organization for Economic Co-operation and Development, 1972.

Jantsch, E. Design for Evolution. New York: Braziller, 1975.

_____. Toward interdisciplinarity and transdisciplinarity in education and innovation. In Interdisciplinarity. Problems of Teaching and Research in Universities. Centre for Educational Research and Innovation. Organization for Economic Co-operation and Development, 1972, pp. 97-121.

Johnson, H. C. Not one unnecessary wriggle: Some questions about the presuppositions of C/PBTE. Educational Theory, 1975, 25, 156-167.

Johnson, R. F. Analysis and design as a conceptual basis for teaching textiles and clothing. Proceedings of the National Meeting, Association of College Professors of Textiles and Clothing. Salt Lake City: Brigham Young University Press, 1974.

Joyce, B. Variations on a systems theme: Comprehensive reform in teacher education. In B. Joyce & M. Weil (Eds.), Perspectives for Reform in Teacher Education. Englewood Cliffs: Prentice-Hall, 1972.

Kagan, J., Moss, H. A., & Sigel, I. E. Psychological significance of styles of conceptualization. Society for Research in Child Development Monographs, 1963.

Kaplan, A. The Conduct of Inquiry. New York: Intext, 1964.

Karlins, M., & Lamm, H. Information search as a function of conceptual structure in a complex problem-solving task. Journal of Personality and Social Psychology, 1967, 5, 456-459.

Katz, D., & Kahn, R. L. Common characteristics of open systems. In F. E. Emery (Ed.), Systems Thinking. Baltimore: Penguin, 1971.

Keller, F. S. Good-buy, teacher . . . . Journal of Applied Behavioral Analysis, 1968, 1, 79-89.

Kerr, D. H., & Soltis, J. F. Locating teacher competency: An action description of teaching. Educational Theory, 1974, 24, 3-16.

Kidd, R. V., & Natalicio, L. T. S. Competency-based learning: An analysis of polyadic interaction. In R. W. Burns & J. L. Klingstedt (Eds.), Competency-Based Education. An Introduction. Englewood Cliffs: Educational Technology Publications, 1973.

Kimball, S. T. Culture, class, and educational congruency. In S. Elam & W. P. McLure (Eds.), Educational Requirements for the 1970's. An Interdisciplinary Approach. New York: Praeger, 1967.

Klingstedt, J. L. Philosophical basis for comptency-based education. In R. W. burns & J. L. Klingstedt (Eds.), Competency-Based Education. An Introduction. Englewood Cliffs: Educational Technology Publications, 1973.

Knott, B. What is a competence-based curriculum in the liberal arts? Journal of Higher Education, 1975, 46, 25-39.

Kogan, N. Educational implications of cognitive styles. In G. S. Lesser (Ed.), Psychology and Educational Practice. Glenview: Scott Foresman, 1971.

Krantz, M. The Advent of the Urban Superchild. Unpublished manuscript, 1975.

Krathwohl, D. R., Bloom, B., & Masia, B. Taxonomy of Educational Objectives: Affective Domain. New York: David McKay, 1964.

Kuhn, A. The Logic of Social Systems. San Francisco: Jossey-Bass, 1974.

Laszlo, E. The meaning and signifcance of general systems theory. Behavioral Science Journal of the Society for General Systems Research, 1975, 20, 9-24.

_____. The Systems View of the World. New York: Braziller, 1972.

Lefrancois, G. R. Psychological Theories and Human Learning: Kongor's Report. Monterey: Brooks/Cole, 1972.

Leonard, G. B. Education and Ecstasy. New York: Dell, 1968.

Lewin, K. Principles of Topological Psychology. New York: McGraw-Hill, 1936.

Lippitt, G. L. Visualizing Change. Model Building and the Change Process. Fairfax: NTL Learning Resources Corporation, 1973.

Maccia, E. S. An educational theory model: Information theory. In E. S. Maccia, G. S. Maccia, & R. E. Jewett (Eds.), Construction of Educational Theory Models. Cooperative Research Project No. 1632. Columbus: The Ohio State University Research Foundation, 1963.

Maccia, G. S. An educational theory model: General systems theory. In E. S. Maccia, G. S. Maccia, & R. E. Jewett (Eds.), Construction of Educational Theory Models. Cooperative Research Project No. 1632. Columbus: The Ohio State University Research Foundation, 1963.

Macdonald, J. B. A systems approach for defining teaching. In R. T. Hyman (Ed.), Contemporary Thought on Teaching. Englewood Cliffs: Prentice-Hall, 1971.

_____. Myths about instruction. Educational Leadership, 1965, 22, 571-617.

Macdonald, J. B., Wolfson, B. J., & Zaret, E. Reschooling Society: A Conceptual Model. Washington, D.C.: Association for Supervision and Curriculum Development, 1973 (ERIC Document Reproduction Service No. ED082288).

Maclin, J. J. Analysis of the Proctor and Self-Paced Components of the Personalized System of Instruction. Unpublished doctoral dissertation, The University of Tennessee, 1974.

Mager, R. F. Preparing Instructional Objectives. Belmont: Lear Siegler, Inc./Fearon, 1962.

McClelland, D. C. Testing for competence rather than intelligence. American Psychologist, 1973, 10, 1-14.

McInnis, N. F. Getting with instructional systems and getting instructional systems with it. Educational Technology, 1969, pp. 40-43.

McLachlan, J. F. C., & Hunt, D. E. Differential effects of discovery learning as a function of student conceptual level. Canadian Journal of Behavioral Science, 1973, 5, 152-159.

Meeth, L. R. The characteristics of competency-based curricula. Regional Spotlight, Southern Regional Board, 1974, pp. 5-7.

Menges, R. J. Assessing readiness for professional practice. Review of Educational Research, 1975, 45, 173-207.

Messick, S. The criterion problem in the evaluation of instruction: Assessing possible, not just intended outcomes. In L. Sperry (Ed.), Learning Performance and Individual Differences: Essays and Readings. Glenview: Scott, Foresman, 1972.

Miller, G. A. The magical number seven, plus or minus two: Some limits on our capacity for processing information. The Psychological Review, 1956, 63, 81-97.

Miller, J. G. Living systems: Basic concepts. Behavioral Science, 1965a, 10, 193-237.

_____. Living systems: Cross-level hypotheses. Behavioral Science, 1965b, 10, 380-411.

_____. Living systems: Structure and process. Behavioral Science, 1965c, 10, 337-379.

_____. Toward a general theory for the behavioral sciences. American Psychologist, 1955, 10, 515-531.

Nardine, F. E. The development of competence. In G. S. Lesser (Ed.), Psychology and Educational Practice. Glenview: Scott, Foresman, 1971.

National Goals and Guidelines for Research in Home Economics. A study sponsored by: Association of Administrators of Home Economics. Jean Schlater, Director. East Lansing: Michigan State University, 1970.

New Webster's Dictionary of the English Language. College Edition. Chicago: Consolidated Book Publishers, 1975.

Noddings, N. Competence theories and the science of education. Educational Theory, 1974a, 24, 356-364.

_____. Teacher competency: An extension of the Kerr-Soltis model. Educational Theory, 1974b, 24, 284-290.

Packer, C. K., & Packer, T. Cybernetics, information theory and the educative process. In R. T. Hyman (Ed.), Teaching: Vantage Points for Study (2nd Ed.). New York: Lippincott, 1974.

Pascal, C. E. Individual differences and preferences for instructional methods. Canadian Journal of Behavioral Science, 1973, 5, 272-279.

Rhetts, J. E. Attribute treatment interactions and individualized instruction: A conceptual framework and an example from project PLAN. In L. Sperry (Ed.), Learning Performance and Individual Differences. Glenview: Scott Foresman, 1972.

_____. Task, learner, and treatment variables in instructional design. Journal of Educational Psychology, 1974, 66, 339-347.

Robinson, J. E., & Gray, J. L. Cognitive style as a variable in school learning. Journal of Educational Psychology, 1974, 66, 793-799.

Rosenblueth, A., Weiner, N., & Bigelow, J. Behavior, purpose, teleology. In W. Buckley (Ed.), Modern Systems Research for the Behavioral Scientist. Chicago: Aldine, 1968.

Ryans, D. G. A model of instruction based on information system concepts. In J. B. Macdonald & R. R. Leeper (Eds.), Theories of Instruction. Washington, D.C.: Association for Supervision and Curriculum, 1965.

Sandoz, E. CBTE: The nays of Texas. Phi Delta Kappan, 1974, 55, 304-306.

Schroder, H. M. Conceptual complexity and personality organization. In H. Schroder & P. Seudfeld (Eds.), Personality Theory and Information Processing. New York: Ronald, 1971, pp. 240-271.

Schroder, H. M., Driver, M. J., & Streufert, S. Human Information Processing. New York: Holt, Rinehart and Winston, 1967.

Schroder, H. M., Karlins, M., & Phares, J. O. Education for Freedom. New York: John Wiley and Sons, 1973.

Silberman, C. E. Crisis in the Classroom. The Remaking of American Education. New York: Random House, 1970.

Singh, J. Great Ideas in Information Theory, Language and Cybernetics. New York: Dover, 1966.

Skinner, B. R. Science and Human Behavior. New York: Macmillan, 1953.

Sommerhoff, G. The abstract characteristics of living systems. In F. E. Emery (Ed.), Systems Thinking. Baltimore: Penguin, 1971.

Sperry, L. Learning Performance and Individual Differences. Glenview: Scott, Foresman, 1972.

Steidl, R. E. An Ecological Approach to the Study of Family Managerial Behavior. Presented at the meeting of a National Conference, The Family: Focus on Management. Pennsylvania State University, 1969.

Streufert, S., & Schroder, H. M. Conceptual structure, environmental complexity and task performance. Journal of Experimental Research in Personality, 1965, 1, 132-137.

Streufert, S., Suedfeld, P., & Driver, M. J. Conceptual structure, information search, and information utilization. Journal of Personality and Social Psychology, 1965, 2, 736-740.

Suedfeld, P., & Hagan, R. L. Measurement of information complexity: 1. conceptual structure and information pattern as factors in information processing. Journal of Personality and Social Psychology, 1966, 4, 233-236.

Sullivan, E. V. Developmental and contemporaneous individual differences and their role in curriculum decision making and teacher training. In B. Joyce and M. Weil (Eds.), Perspectives for Reform in Teacher Education. Englewood Cliffs: Prentice-Hall, 1972.

Taschdjian, E. A systems approach to higher education with special reference to the core curriculum. Policy Sciences, 1972, 3, 219-233.

Thomson, R. The Psychology of Thinking. Baltimore: Penguin, 1964.

Toffler, A. Future Shock. New York: Bantam, 1971.

Tomlinson, P. D., & Hunt, D. E. Differential effects of rule-example order as a function of learner conceptual level. Canadian Journal of Behavioral Science, 1971, 3, 237-245.

Vaines, E. L. An Ecological Systems Framework for Home Economics/ Human Ecology: The Linkage of Environment, Energy and Organism as Family. Unpublished doctoral dissertation, Michigan State University, 1974.

Valeski, T. A Continuum Model for Competency Based Training. Washington, D.C.: Rocky Mountain Regional Resource Center, Office of Education, Department of Health, Education and Welfare, 1974 (ERIC Document Reproduction Service No. ED083706).

Verzaro-Lawrence, M. Practical Considerations for the Multiple Model Programming Concept. Presented at the meeting of American Educational Research Association, San Francisco, 1976.

Weiner, N. The Human Use of Human Beings. Cybernetics and Society. New York: Avon, 1967.

White, R. Motivation reconsidered--The concept of competence. Psychological Review, 1959, 16, 297-333.

Witkin, H. A., Dyk, R. B., Faterson, H. S., Goodenough, D. R., & Karp, S. Psychological Differentiation. Studies in Development. New York: John Wiley and Sons, 1962.

APPENDIXES

APPENDIX A

ORIGINAL LETTERS AND OPINIONNAIRE MAILED TO JUDGES

THE UNIVERSITY OF TENNESSEE
KNOXVILLE
COLLEGE OF HOME ECONOMICS

DEPARTMENT OF TEXTILES AND CLOTHING

April 17, 1977[1]

Dear

I am a student in the College of Home Economics' interdisciplinary doctoral program at the University of Tennessee. The emphasis of my study and research has been in textiles and clothing and curriculum and instruction. A major objective of my dissertation is the development of multidimensional competence development models based on ecosystem theory.

You have been identified as an educator involved in related areas of study, therefore, qualified to provide feedback toward the validation of the models. Assistance will involve completion of an opinionnaire concerning the function and use of the models.

The models are intended as vehicles for assessing both content and process competence, at any level of learning. They could provide a foundation for other researchers interested in developing learner competence. Please indicate your willingness to complete the opinionnaire by mailing the enclosed card by Monday, April 25.

If you would like additional information please call collect at 1-512-471-4287 (daytime) or 1-512-452-4668 (evenings).

Sincerely,

Ardis M. Rewerts
Assistant Professor
Department of Home Economics
University of Texas
Austin, Texas 78712

Major Professor:
Dr. Charles J. Noel
Associate Professor
College of Home Economics
University of Tennessee
Knoxville, Tennessee 37916

[1]Appendix A is a reduced duplication of the original letters and opinionnaire sent to the judges.

THE UNIVERSITY OF TENNESSEE
KNOXVILLE
COLLEGE OF HOME ECONOMICS

DEPARTMENT OF TEXTILES AND CLOTHING

Dear

Thank you for agreeing to complete the opinionnaire concerning the competence models developed in my dissertation work at the University of Tennessee. Enclosed find a packet explaining the framework and purposes of the models. You are requested to react to these materials on the opinionnaire provided. Your assistance is valuable in completing the comprehensive models intended for use in assessing competence development in a complex and changing society.

An envelope is provided for returning the opinionnaire by May If you would like additional information please call collect at 1-512-471-4287 (daytime) or 1-512-452-4668 (evenings). The results of the study will be available for review during Fall, 1977.

I appreciate your time and cooperation in making this research a success.

Sincerely,

Ardis M. Rewerts
Assistant Professor
Department of Home Economics
University of Texas
Austin, Texas 78712

Major Professor:
Dr. Charles J. Noel
Associate Professor
College of Home Economics
University of Tennessee
Knoxville, Tennessee 37916

A COMPETENCE MODEL BASED ON ECOSYSTEM THEORY
Opinionnaire Packet

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I. A COMPETENCE MODEL BASED ON ECOSYSTEM THEORY

A. Introduction

The development of learner competence is an overriding goal of education. Attention has been given to competence from several vantage points, ranging from White's (1959) concept of an organism interacting effectively with its environment to the competency-based (CBE) education context of learning specified competencies considered important for effective performance in a career or profession (Schmieder, 1974). Competence in both content and learning process must be viewed in a perspective congruent with coping, adapting, and growing as society changes at an increasing pace and complexity.

B. Definition of General System Theory

General system theory (GST) is general theory of systems. Properties or characteristics of a system and the relationships among their functions jointly describe a system. These aspects apply to matter, energy and information. Open systems' states are determined by interaction with the environment (Laszlo, 1975).

Characteristics of GST include the following:

- GST is multidisciplinary
- GST may correct for deficiencies of overspecialization
- GST is capable of societal application
- GST has the capacity for synthesizing operationalized bodies of knowledge

The directives of competence may be seen as proximal and distal, within and outside the learner. Each is changing as society changes in increasing speed. As fields of study direct their objectives toward societal need, the complexities of environmental impingements on the learner increase. Increased coping skills are required which allow the learner to continue to develop competence after acquisition of degrees or diplomas.

Model I represents the competence development qualities and process as being dynamic and continuing and unique to each learner. Each learner is structured by environmental influences which continually affect change in the learner structure.

Model II provides a means for assessing learner state diagnosing for appropriate competence direction and assignment of goals based on feedback from perceptions of learner/system and environmental feedback traced in Model I.

Models I and II build a framework for:

- defining boundaries based on current learner/system competence and goals.
- changing boundaries and intersystem interfaces as feedback from acquired competence directs change and increased complexity.
- viewing environmental impingements on changing content and learning process as well as learner/system state
- viewing learner/system competence at any level or stage of development
- viewing learner/system competence based on any goals
- viewing competence development after formal education ends

- use by learners, instructors, administrators and others
- assessing groups or individuals
- developing research projects and instructional methods

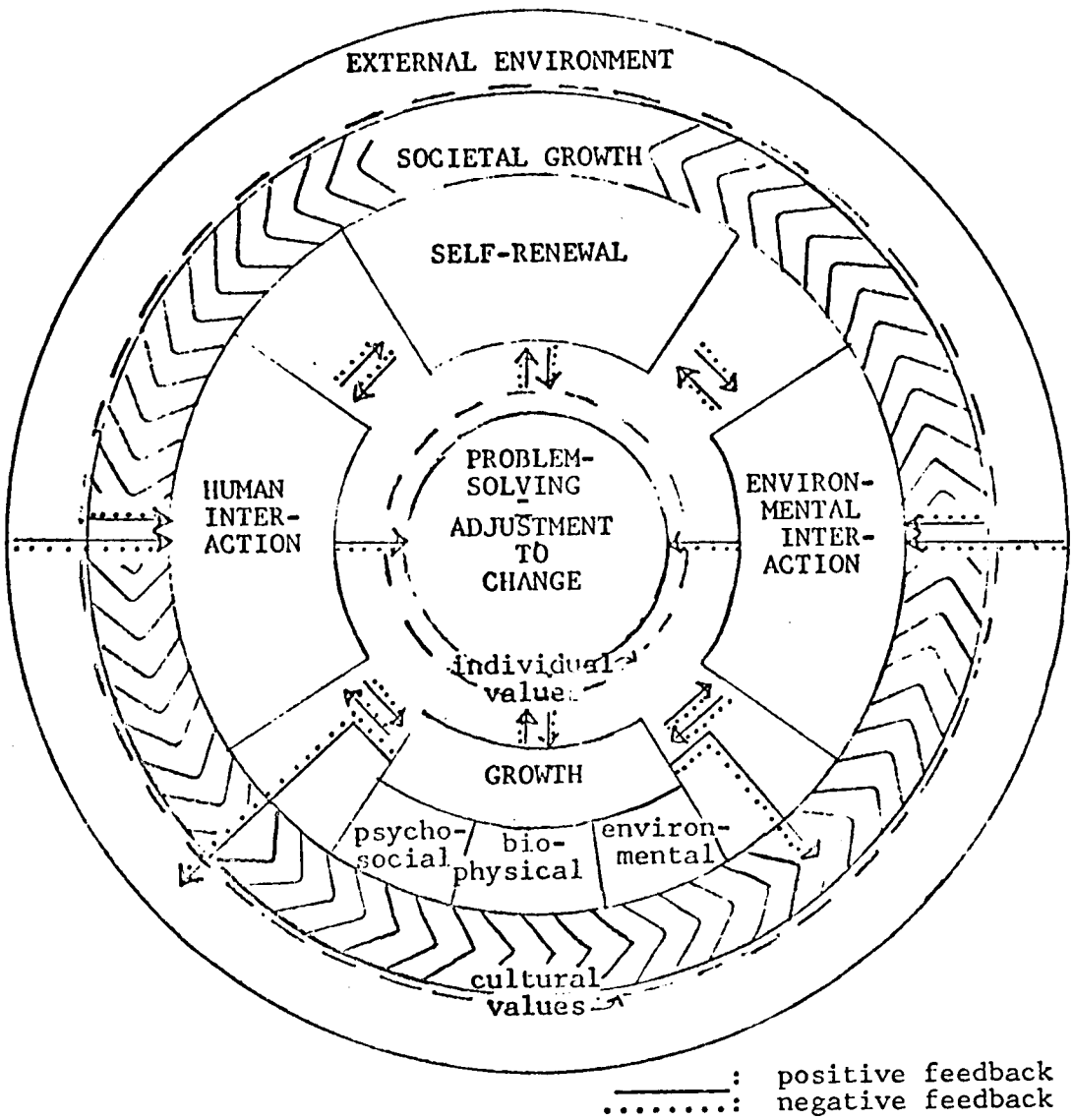
E. Two Models for Viewing Competence Development

Model I includes sources of environmental influence on learner competence development. The phases of competence development are represented. Model II represents a more intense concentration of the integration and increasing complexity of process and content competence typical of the goal-directed atmosphere of a school setting.

Competence is considered to be accomplishment of steps of growth toward goals. The nature of competence development varies among learner/systems with direction depending on structure at the time of assessment. It is a source of feedback for directing increasing competence toward goals.

Model I: A Global Perspective

Model I represents a global perspective for competence development. Learner/system structure is subdivided into psycho-social, bio-physical and environmental factors, each of which influences competence development within the learner. The near environment of the learner is divided into human environmental and physical environmental interactions. Each of these is relative in its influence, depending on the system of concern. Flexibility of boundaries varies.



MODEL I. Competence Development

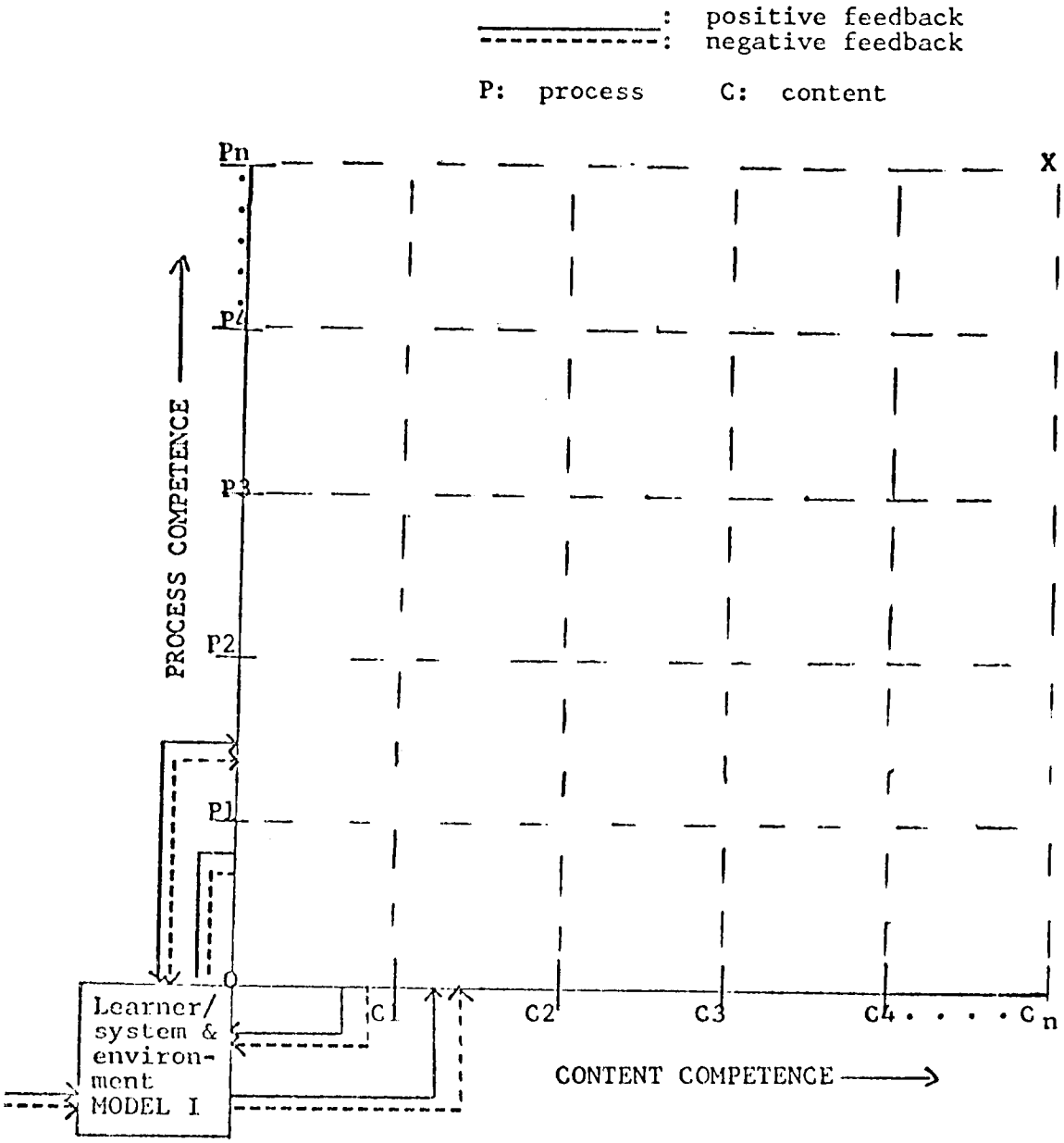
Student growth toward goals is governed by the student's use and perception of information from the environment. The suprasystem (external environment) is considered to have less direct influence on the learner/system, but cannot be overlooked. Neither can the influence of learner competence on societal growth be ignored.

In Model I, the actual process of growth in a specified learner/system is depicted in three sections. Self-renewal may be seen generally as a plateau, or a sorting-out phase. Actual competence development occurs after the self-renewal phase (if the self-renewal phase is indeed needed). The process may involve a subtle adaptive competence, adjustment to change, or directed change toward specified goals. The change process is represented in the model by the center of the circle, termed adaptation, problem solving, or change. The point of assessment of an identifiable behavior change or measureable increase in ability to receive and process information is represented by growth. Growth, in general, is much broader and less predictable than formalized directed learning based on goals. Growth occurs even when not involved in a formalized learning environment.

Model II: Multidimensional Competence Development

Model II provides a more intense view of the actual process of competence development for specified individuals. Given a pluralistic attitude toward competence development, an ecosystem framework offers a means for viewing all

7



MODEL II

Process and Content Competence

integrated factors but on an individual learner basis. Critical ingredients will vary in time/space and with specified learners and investigator interests.

Measurement of the degree of sophistication acquired in dealing with the content of a discipline is depicted on the horizontal axis. One aspect of increasing content complexity may be that of taking an interdisciplinary perspective to a societal problem.

The vertical axis of the model represents increasing complexity of process in competence development. The process of competence development involves change in complexity of system structure with greater complexity in competence sought. An environmental component is assumed in the process axis in that increased competence involves dealing with an increasingly complex environment. Thus, information processing skills within the learner increase in complexity. The nature of competence as feedback will determine the extent of development allowed.

F. Advantages of Models I and II for viewing competence development based on ecosystem theory

- they provide tools for visualizing competence development holistically
- interrelationships among variables are identified
- competence development may be seen as developmental and increasing in complexity
- a static representation of competence may be viewed at one place in time/space when appropriate

- the models represent competence development in both content and learning process

G. Disadvantages of a model for viewing competence development in an ecosystem framework

- oversimplified conceptualization may be formed of competence development
- difficulty may come in applying the principles in real situations

H. Use of the model in a specified content area--textiles in home economics

Home Economics is the study of families in the context of their near environment. Textiles is a vital component of the near environment. The relevance of this content area to families is only realized as it is viewed in interaction with other components of family environment. At the same time textiles is one aspect of base disciplines of history, art, chemistry, physic and others, so must be looked at in an interdisciplinary context. Inherent complexity and required integration of disciplines suggests the appropriateness of an ecosystem framework for viewing developing competence in textiles. Working with the complexity of interdisciplinary content implies uniqueness in learning process development. A linear framework of competence development in textiles does not provide for the integration of disciplines or the complex learning processes within the learners and among learners interested in the different aspects of this interdisciplinary topic.

I. Summary

Models I and II are vehicles to be used by learners as well as educational practioners from varying vantage points. Using an ecosystem conceptual framework and a broad (Model I) and/or narrow (Model II) perspective, learner structure may be portrayed as a complex system in dynamic interaction with the environment. A study of the nature of the learner as system and the quality of the information exchange with identified components of the environment allows for effective use of competence as feedback for direction of increased complexity in learner growth.

II. COMPETENCE DEVELOPMENT WITHIN AN ECOSYSTEM FRAMEWORK: OPINIONNAIRE

Please check the response that best represents your opinion of each of the statements below. Space for comments is provided.

STATEMENT	Strongly Agree 5	Agree 4	Uncertain 3	Disagree 2	Strongly Disagree 1
1. The learner is the central focus in competence development. Comment_____					
2. The central focus of competence development is the organism as learner in the context of the near environment. Comment_____					
3. Professionals in education perceive learning as multidimensional Comment_____					
4. Models I and II represent a global perspective of competence development as continual change in learner toward goals. Comment_____					
5. The learner/system is continually exchanging energy and/or information with the environment. Comment_____					
6. Models I and II are means of helping educators delineate all inter- and intra-system factors affecting learner/system growth. Comment_____					
7. Theory, research, curriculum and instruction may be directed and assessed in the context of Models I and II. Comment_____					

STATEMENT	5	4	3	2	1
8. Within Models I and II the learner/system may be perceived as interacting with systems in the near and distal environment. Comment_____					
9. The ecosystem framework of Models I and II provides a more complete view of competence development than a linear or additive approach to learning based on content. Comment_____					
10. Assessment of the integration of process and content within an ecosystem framework provides a perspective for diagnosing and directing a learner/system's total and continuing development of competence. Comment_____					
11. The ecosystem framework for competence development provides a perspective for learner, instructor and administrator for better preparing the learner/system to understand and cope with change. Comment_____					
12. An ecosystem framework provides an appropriate neutral perspective for illustrating the multidimensional aspects of competence development. Comment_____					
13. Assessment of competence development can act as feedback for directing further competence toward goals. Comment_____					
14. Defining the learner as organism in an ecosystem framework allows for assessment of learner competence at all ages, levels and aspirations. Comment_____					
15. System concepts provide concepts which represent all learners at all levels of competence. Comment_____					

STATEMENT	5	4	3	2	1
16. Competence development includes both content and process development. Comment_____					
17. Both content and learning process increase in complexity and one affects the progress of the other. An ecosystem framework allows for study of their interrelationships. Comment_____					
18. A neutral ecosystem perspective to competence development allows for application of varying, selectively applied learning theories and philosophies based on system structure at a given time and space in competence development. Comment_____					
19. A unity between content and process may be conceptualized and implemented more easily using one theoretical framework. Comment_____					
20. Home Economics may be viewed as a study of the family in its ecosystem. Comment_____					
21. Textiles may be viewed as a component in an organism's near environment. Comment_____					
22. The "whole" of competence is greater than the sum of its parts. Comment_____					

23. Additional comments:

III. GLOSSARY OF TERMS

General System Theory	General theory of systems
Ecosystem	The system of concern is an organism in interaction with its environment.
System	A set of units with relationships which tie them together (1). System relativity assumes the two following opposite poles: Open system: A system which exchanges materials, energies, and information with its environment (7). Closed system: A system in which there is no exchanges of components with the environment.
Environment	Any set of objects a change in whose attributes affect the organism and vice versa (1).
Boundary	Unique system and components of concern at time of analysis.
Information	Content of what is exchanged with the environment. It is a measure of organization. The inverse of information is entropy. It is a measure of disorganization (8).
Feedback	Information exchanged with the environment and used by the system to determine the nature of that transaction. The relativity of feedback assumes the following opposite poles: Negative feedback: This reduces the amount of information input, thus leading to greater system stability, thus, minimum growth (4). Positive feedback: This adds to input signals rather than correcting them. Growth is a function of positive feedback.

IV. BIBLIOGRAPHY

1. Hall, A. D. and Fagan, R. E. "Definition of System." In W. Buckley (Ed.), Modern Systems Research for the Behavioral Scientist. Chicago: Aldine Publishing Co., 1968.

2. Hook, Nancy C. and Paolucci, Beatrice. "The Family as an Ecosystem." Journal of Home Economics, 1970, 62, 315-318.

3. Laszlo, Ervin. "The Meaning and Significance of General Systems Theory." Behavioral Science Journal of the Society for General Systems Research, 1975, 20, 9-24.

4. Rosenblueth, A., Weiner, N. and Bigelow, J. "Behavior, Purpose, Teleology." In W. Buckley (Ed.), Modern Systems Research for the Behavioral Scientist. Chicago: Aldine Publishing Co., 1968.

5. Schmieder, Allen. Competency-Based Education: The State of the Scene. Washington, D. C.: American Association of Colleges for Teacher Education and the ERIC Clearinghouse on Teacher Education, 1973.

6. Sommerhoff, G. "The Abstract Characteristics of Living Systems." In F. E. Emery (Ed.), Systems Thinking. Baltimore: Penguin Books Inc., 1971.

7. vonBertalanffy, Ludwig. General System Theory. New York: George Braziller, 1968.

8. Weiner, Norbert. The Human Use of Human Beings. Cybernetics and Society. New York: Avon Books, 1967.

9. White, Robert. "Motivation Reconsidered--The Concept of Competence." Psychological Review, 1959, 16, 297-333.

APPENDIX B

COMMENTS BY JUDGES ON THE OPINIONNAIRE

Comments extended by judges on the opinionnaire are listed according to the statement number to which the comment refers. Statements have been reproduced verbatim.

1. - "a" central focus
   - less specific than #2

2. no comments

3. - not necessarily same response for "prof. educators"
   - they should but many do not
   - lack of professional understanding . . . is the BIG problem!

4. - I think we disagree on the meaning of global.
     I do agree the models facilitate viewing your problem as holistic.
   - not necessarily by directly proportional increments as shown in Model II.
   - I does; II more specific
   - Model I seems to

5. - This also appears on p. 1 of your text.
     I believe this is the way "energy" is structured:

                ENERGY
                  1. MATTER ENERGY
                  2. Information
                     (communication is a subset of information
                      and is defined as patterned information.)

     I agree with your statement. I think it needs to be tightened to read accurately.
   - If learning is occurring

6. - I think most but by education and nature: all is too inclusive for me.
   - "all" can't be perceived
   - "all" is too inclusive
   - "some"
     We need additional res. to identify other relevant variables.
   - I'm not sure I can agree with the words "delineate all."
   - They could be

7. - needs application
   - not theory and research--unless one means, possibly, competence development of the theoretician or researcher.
   - theory and curr., clearly
     res.--some problems
   - It looks plausible

8. no comments

9. - But Model II still looks linear?
   - But I'm biased in that direction

10. - I don't understand the statement
    - provides perspective but still difficult to operationalize
    - "total"
    - If person using it truly understands the conceptual framework

11. - It has the potential to achieve this goal I think
    - needs more discussion of "critical mass" or a concept of having appropriate ingredients for time/space/materials/process integration to be evident

12. - If you delete "neutral"; the statement reads so I can agree.
    - No observer is neutral, there is always systemic bias
    - That's its greatest advantage

13. - again basic strength of any systems approach

14. - if elements are accurately and clearly identified and explained at each level of interaction

15. - Again I think my problem are the "alls" again. If 'rules' are used correctly; then systems theory does help organize levels and consistency between levels. Back to your statement. Given the way it is stated; I would hesitate to agree. It is too bad we can't have a discussion.

    - Content/learner interactions are too diverse & complex to be understood by a generalized model (ex: Einstein working out mass/energy relationships vs. a 5 yr. old tying shoelaces)

16. - traditionally viewed as primary content, actually process even of great importance.
    - process is probably more critical than content in view of the "forgetting rate" of the learner

17. - not necessarily, there may be plateaus
    In science, acquiring "tool" knowledge may fit 17, but once certain tool/knowledge is attained certain learning may proceed in a less complex means to another level.

18. - Sorry I do not clearly understand the statement.
    I do not believe a perspective can be neutral. (or value free)-
    - managed or controlled bias (in lieu of neutral) is more acceptable to me

19. - probably
    - Model II still needs work!
    - too general
    - depends on the limitations of the conceptualizer
    - complex components may need to be viewed from several perspectives independently at introductory levels
    - seems it would depend on <u>which</u> framework

20. - should be

21. - component of the human near environment
    - a much neglected one

22. - yes; I think so. At least from the way you define competence
    - it is synergistic in nature--an essential concept
    - depends on how one quantifies it

23. Additional comments:

    - the concept of "stress" may be useful as the motivating force in system movement/growth.
      Good work - reflects alot of synthesis of ecological propositions in the context of learning. I find Shroder's Information Processing work useful in this context also.
      Models are not self explanatory--need something . . . . Model I simplified and visualized as 3-d--Model II perhaps

      process

      content

      this kind of movement??

    - Beware of attempting to understand extremely complex interactions with 2-dimensional, arbitrarily spaced models.

    - Interesting study--your sample, however, would need broad based familiarilty of the concepts to get "get it" just from reading your intro.

VITA

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