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Systems Methodology: Applications to Extension and Teaching

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Varying degrees of criticism have been leveled at the U.S. higher education system. The increasing money costs to obtain the bachelor's degree, and degree recipients who are noncommunicative, non-decision makers, and not exposed to the liberal arts have been voiced as deficiencies of the system. The Carnegie Commission has recently recommended reevaluation of our universities' curricula and philosophies and U.S. Secretary of Education, William Bennett, has crusaded for education overhaul.

The National Agricultural and Natural Resources curriculum project, formed by personnel of the United States Department of Agriculture, Land Grant Colleges, and industry representatives under the chairmanship of Dr. Richard Merritt of Rutgers University, has also addressed educational reform. Their major recommendation was to introduce Systems Methodology and Ethics into the undergraduate curricula. A 10-day national workshop was held at Colorado State University in 1986, entitled "Systems Approaches to Food and Agricultural Problems." Forty-three agricultural economists, agronomists, and agricultural engineers participated. A similar workshop that addressed ethics and curriculum was held during June 1987, at the University of Kentucky.

This paper presents systems methodology applied to extension and undergraduate instruction. Why systems methodology? What perspective does systems methodology bring to education? In the March 3, 1987, issue of *USA Today* there was an article by Dennis O'Brien, President of the University of Rochester, entitled, "It's Simply Classical Economics." I will quote portions of this article for it brings the needed perspective to systems methodology as applied to extension and undergraduate instruction:

"The most interesting aspect of Secretary of Education, William J. Bennett's crusade for collegiate economy is his touching belief that he knows the proper form of the college curriculum. . . .

Bennett is one of the great educational theorists of the 19th century. His views are a tribute to his Alma Mater, Williams College, and its famous 19th century President, Mark Hopkins. No less a person than James A. Garfield said that all you need for a good education is 'a student on one end of a log and Mark Hopkins on the other.' Hopkins himself stated there was only one book needed in the library, the bible.

Well one book, one log, and one teacher make for pretty economical education. The 19th century classical curriculum, fixed in content, direct in instruction, and sure in its moral assumptions, was a model of efficiency. . . . I have great sympathy with the Secretary's urge to revive the classics, but the classical curriculum just won't do for the 20th-21st century.

Somehow, Bennett has forgotten the rise of science, which played no role in the classical curriculum. If the classical curriculum delivered old truths, the scientific curriculum discovers new truths . . . The modern college curriculum is not only scientific by addition, it is scientific throughout. We discover not only physical laws, but review our economic, political, artistic and moral scholarship . . . However, the Secretary is correct: On the model of 19th century collegiate education modern universities are inefficient. The fundamental issue is, do we want an educational delivery service or an instrument of discovery?

I propose that systems methodology is an instrument of discovery. Through this problem based learning approach, also known as experiential learning, the students' communicative and decision making skills and managerial leadership can be expanded.

The three goals of this presentation are to: describe system-oriented learning, introduce you to experiential learning, and summarize systems methodology as applied to extension and resident instruction issues.

Students live in the so-called real world that is made up of science, technology, hard systems, and soft systems.¹ There is also a conceptual world of reductionism and holism (Figure 1). One may think of science as the heart of reductionism. The problem has been reduced, primary observations made,

¹ Based on material presented at the Workshop, Systems Approach to Food & Agriculture Problems, National Agricultural and Natural Resources Curriculum Project, Colorado State University 1986.

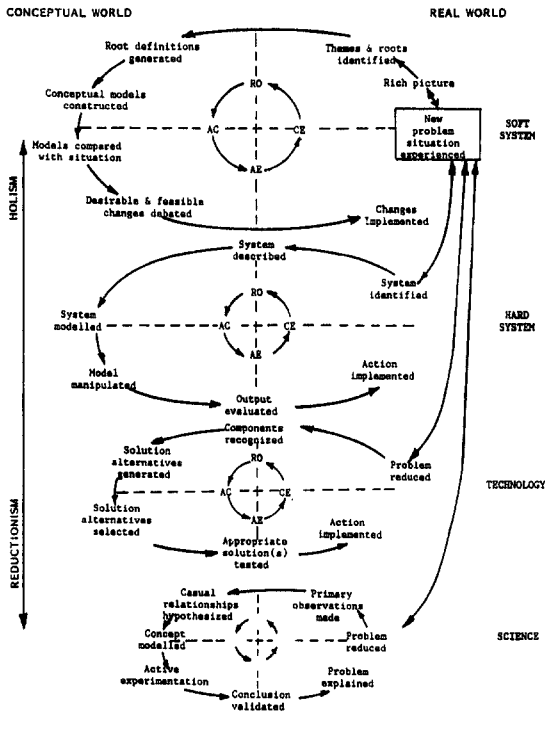
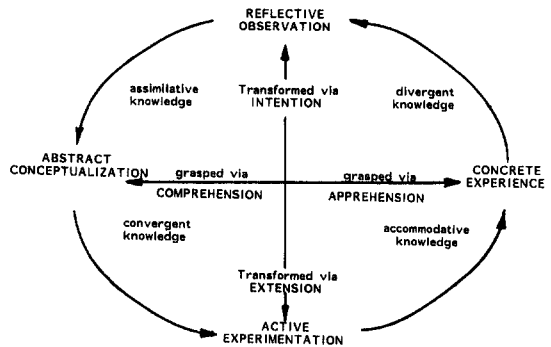


Figure 1. A Spiral of Methodologies

Bawden, R.J., *Problem Based Learning: An Australian Perspective: Education for Professionals—Higher Education Research & Development Society of Australia, 1985.*

causal relationships hypothesized, the concept modelled, experimentation actively undertaken, conclusions validated, and the problem explained. After many repetitions of reducing the problem, hypothesizing, experimenting, and explaining the problem, postulates and laws are founded. Technology grows from science. A problem is reduced, its components recognized, solution alternatives are generated, solution alternatives are selected, appropriate solution(s) are tested, and eventually action is implemented. Hard systems approach holism. The system is identified, described, modelled, the model manipulated, output evaluated, and action implemented. Much of the farming systems work being done in less developed countries follows the hard systems approach. At the apex of holism is the soft system. A new problem situation is experienced, a rich picture is created, themes and roots are identified, root definitions are generated, conceptual models constructed, models are compared with the problem situation, desirable and feasible changes are debated, and finally changes are implemented. Envision a spiral going from soft systems to hard systems to technology to science. In the real world

knowledge flows downward and upward. In the conceptual world holism gives way to reductionism. Soft systems methodology integrates values into the model. In a sense it brings the positive and normative together in the problem situation. It also brings observed personal views and positions into the model. When developing root definitions a formal framework is used. Each time a root definition is generated clientele, actors, transformation, world view, owners, and environmental constraints are incorporated in the definition. The clientele are most affected by the problem, the actors are the various parties involved, transformation refers to the issue or problem that will be made better, world view recognizes the individuals view of the situation, owners have control over the outcome, and environmental constraints indicate the attitudes, consensus, or disagreement surrounding the issue.



The Lewin/Kolb Model of Experiential

Source: Kolb, D.A., *Experiential Learning: Experiences as the Source of Learning and Development*, Prentice Hall, 1986.

Note that in the center of each systems-science interaction circle rests another circle. This represents the Lewin/Kolb model of experimental learning. Each of us has a different propensity to learn and we do so through (CE) Concrete Experience, (RO) Reflective Observation, (AC) Abstract Conceptualization, and (AE) Active Experimentation. A recognition of different learning styles is basic to experiential learning and the application of soft systems methodology.

Four types of learners are identified as they relate to the experiential learning propensities. Learners who relate more to concrete experience and reflective observation are endowed with divergent knowledge. Learners who relate to reflective observation and abstract conceptualization are said to possess assimilative knowledge. Learners falling between abstract conceptualization and active ex-

perimentation have convergent knowledge and those who relate more to active experimentation and concrete experience possess accommodative knowledge.

Lewin/Kolb indicate the following characteristics for the different learners:

Diverger—Concrete experience, reflective observation, imaginative ability, many perspective view of concrete situations, idea generator, brainstormer, people oriented, imaginative, emotional broad cultural interests.

Assimilator—Abstract conceptualization, reflective observation, theoretical modeler, inductive reasoning, assimilates disparate observations into integrated whole, enjoys abstract concepts, not concerned with practical use of theories, appreciates logical, sound, precise theory.

Converger—Abstract conceptualization, active experimentation, practical applications, conventional intelligence tests, likes single answer tests, deductive reasoning, has specific problem focus, unemotional, thing oriented, narrow technical interests.

Accomodator—Concrete experience, active experimentation, likes doing things, carries out plans and experiments, appreciates new experiences, risk taker, adapts to circumstances, intuitive, trial and error approach, relies on advisors, impatient, wants to get things done.

Lewin/Kolb have developed a learning style inventory that classifies individuals as either divergers, assimilators, convergers, or accomodators. The student can also compare his or her tendencies towards concrete experience, reflective observation, abstract conceptualization, and active experimentation with statistical norms.

After students and instructor recognize that different learning styles exist, exercises and case stud-

ies that attempt to build confidence in decision making and then consensus in problem resolution should be introduced into the learning environment.

Soft systems methodology grows from scientific method but there are some important differences that enhance decision making and improve managerial skills. Checkland² has outlined seven parts of the methodology. The problem system is unstructured and then expressed. The systems thinker would then develop root definitions of the relevant systems and then create conceptual models relating to the problem. The conceptual model is then compared with the expressed problem situation. Feasible and desirable changes are enumerated and ultimately action to improve the situation is taken.

Soft systems methodology has a place in extension and resident instruction programs. When establishing discussion groups the inclusion of the four learning styles in each group should bring a broader perspective to the issue than a group made up only of divergers, convergers, assimilators, or accomodators. Current problems concerning land use, water quality, policy issues and farm management have systems applications. Obtaining different perspectives on the issue, integrating these perspectives into the model and reaching consensus are a part of systems methodology.

Classroom lecturing will have to give way to students doing and experiencing learning when systems methodology is introduced into the curriculum. Case studies and exercises with professors acting as catalysts and monitors will be a part of the experience.

Systems methodology can be an instrument of discovery.

² Checkland, P. B., *Systems Thinking, Systems Practice*, John Wiley and S. Chichester, 1981.