# CHALLENGE AND RESPONSE: DEVELOPING A SYSTEM FOR EDUCATING MORE EFFECTIVE AGRICULTURALISTS

**Robert D. Macadam and Richard J. Bawden**

*The need for competency-based tertiary education to meet the demands of contemporary agriculture is explored. The response at one Australian agricultural college has been a fundamental reform of its curricula. The aim is to produce graduates who take a holistic approach and are effective problem solvers and situation improvers. A conceptual model of a system to educate the new class of agriculturalists has been developed by reflecting on what has occurred since the review process began in 1978. The model is used to review the change process and reveal insights that may be useful as a guide for similar ventures in other settings.*

Keywords: education, agriculturalists, competency, system, curriculum, problem solving

## INTRODUCTION

A number of studies have revealed a serious mismatch between the capabilities of College and University agricultural graduates and the perceived needs of their employers.[1]

The issue of education for agriculture is complex. Within the agricultural sector there is a mosaic of career opportunities. In addition to farming itself there are many related vocations off-farm. Diplomates, certificate holders and graduates are all to be found within the various support sectors of farm supplies, commodity marketing, product processing and the information service industries. Careers in the latter include research, development, extension, consulting, education and journalism. The situation is further confused by the unco-ordinated plethora of formal course programs offered by over 50 institutions and organisations throughout Australia. All of this is exacerbated by the changes which are occurring in both the agricultural and educational sectors at large, and the socio-economic environments which surround them.

It can be concluded from Kelleher's[2] 1979 survey of post-secondary agricultural education that little improvement had occurred in the sector from the fragmented and functionally confused situation identified in 1973 by Nalson.[3] Whilst some initiatives had been taken

in the interim, particularly in relation to farm management education, there were few indications of fundamental curricula reform. Extant curricula continued to reflect the learning process as an aggregation of 'units' of disciplinary sciences and applied sciences, husbandry technologies, management theory and a wide spectrum of practices. As Lees and his colleagues were to report a few years later of their work which covered the late 1970s, curricula reforms based on any thoughts of competency have been extremely rare in agricultural education circles.[4]

It was these circumstances which combined in the late 1970s to convince the decision-makers at Hawkesbury Agricultural College that drastic changes were called for in their learning environment and an investigation was launched in 1978. Consistent with this goal of reform of their system, faculty decided to examine the *functions* of the School, its *structure,* and the *climate* of support for change.

Table 1 summarises the situation as it existed at the time the reforms began, and as it currently stands.

**TABLE 1**

**Curricula Reform 1978—1985**

| | 1978 | 1985 |
|---|---|---|
| ACCREDITED PROGRAMS | 6 semester Diploma in Applied Science (Agric.) | 7 semester Degree in Applied Science (Agric.)<br>7 semester Degree in Applied Science (Hort.) |
| | 4 semester Associate Diploma in Horticulture | 4 semester Assoc.Dip. in Hort.<br>4 semester Assoc.Dip. in Animal Production<br>4 semester Assoc.Dip in Horse Management (in conjunction with a second college)<br>4 semester Assoc.Dip. in Crop Production |
| | 2 semester Graduate Dip. in Agriculture | 2 semester Graduate Dip. in Agriculture |
| PROGRAMS STRUCTURE | Unitized curricula of science, applied science, technology and management subjects with specialist majors — all involving practical agricultural husbandries. Full-time on campus. | Essentially self-directed curricula based on achievement of a matrix of competencies around problem-solving, effecive communication and autonomous learning. Includes off-campus phases of real world experiences. |
| PROCESS | Lectures and practicals | Experiential (problem-based) strategies. |

| | | |
|---|---|---|
| FOCUS | Reductionist technology | Systems agriculture. |
| ORGANISATIONAL STRUCTURE | Discipline based departments which controlled "majors" with specialised human and physical resources including laboratories and demonstration farms. | Function based management teams for programs, outreach, centralised resources, learning package development, curriculum evaluation and staff development. |
| DECISION-MAKING | Centralised. | Participative. |
| CLIMATE | Relatively conservative. Closed. | Innovative for change. Open. |

More of the background of these changes, including statements of philosophy and details of the manner in which the new focus and processes were incorporated into curricula have been published elsewhere.[5]

This paper focusses on the changes as an application of systems concepts and problem-based learning strategies to the development of the School itself. Thus as well as using this approach to learn how to be effective improvers of problem situations in agriculture, staff and many students have turned their newfound skills to effecting needed changes in the School's functions, structures and climate.

As a first step the circumstances that led to the School accepting the challenge for reform are presented. This is followed by a description of the response as well as the key concepts that guided it. This provides the context for the presentation of a conceptual model which is used to review the change process and reveal insights which may be useful as a guide for similar ventures in other settings.

## THE SITUATION AT HAWKESBURY

Reflection suggests there were six major elements which contributed to Hawkesbury's decision to change. Firstly, many of the academics of the School of Agriculture were playing significant extension roles in the rural sector and were aware of the situation in the industries with which they were connected. They felt that the agricultural education sector was not responding adequately to this situation.

The second factor was associated with the process of reaccreditation of the School's major programme — a three year, technologically biased Diploma of Applied Science. On-going debates to change the curriculum to incorporate new subject disciplines, in farm management economics particularly, had led to high levels of frustration. A sense of considerable unease existed as the process of collective bargaining by discipline based groups for marginal curricular adjustments faltered.

Thirdly, there was a considerable impetus for more fundamental changes to occur in curriculum design on the part of a number of

senior academics. Some of these were involved in postgraduate studies in either education or extension and they had become aware of the possibilities for major adjustments in learning strategies.

Fourthly, an important research project into the nature of the extension process was being conducted in the Department of Communication on the campus.[6] A few of the staff of the School of Agriculture were involved and were aware of some of the observations emerging from the work.

Fifthly, a College wide goals workshop had identified a surprisingly low rating for the areas of "personal development" and "social skills".[7] This identified mismatch between staffs' perception of program objectives and the competencies needed in the vocations that most graduates entered was the source of considerable comment. Sixthly, the position of Head of School became vacant providing an opportunity to attract a leader who could combine some educational expertise with a broad perspective of Australian agriculture.

It was a sensitive and receptive environment into which a Head of School, with significant disposable resources, could catalyse debate on the problems facing the School. As it transpired the appointee came with considerable empathy towards, and some experience in, taking a systems approach to tackling such complex issues. The challenge that was accepted was not just to adjust curricula to be more appropriate to contemporary agriculture, but to effectively design and construct a total organisational system for an innovative learning environment. This would have the purpose of providing current and relevant learning resources to help those involved in agriculture to solve their own problems and improve their own situations. Furthermore, as this would apply to any vocational area within the sector it was important to open up the learning environment to experiences from the real world of agriculture and from those practising within it.

## KEY CONCEPTS

An emphasis on problem solving and situation improving are at the heart of the Hawkesbury approach to learning about agriculture. As with the conclusions reached about medical practice at Newcastle University we have concluded at Hawkesbury that agriculturalists "will always be required to solve and manage problems as one of the most vital skills of their profession".[8]

The major challenge in learning about agriculture has long been to provide some sort of inter-disciplinary perspective into which a wide range of different disciplinary elements can be fitted. As Nalson and his colleagues noted, an integrating element which allowed the biological, environmental, economic and psycho-social factors to be brought together was largely lacking in College curricula at the time of

their survey. Others[9] had suggested that systems approaches to agriculture could provide a vehicle for the integration of learning but our investigations failed to reveal any satisfactory models.

Coupled with a concern for an integrating and problem based learning perspective was a conviction that a learner centred focus should replace the previous teacher centred one. The learning environment that has developed reflects a number of interrelated educational models based on the concept of the learner as an active, problem solving, innovative and creative person. We believe:

- People actively learn throughout their lives whilst trying to understand or take action to improve new experiences or situations in which they constantly find themselves (EXPERIENTIAL LEARNING).
- Both "management" and "technology" are concerned ultimately with the idea of taking effective action — doing something active.
- One action, or problem solution, invariably leads to a reaction or a new problem arising somewhere else in the system. One therefore must take account of the whole (the SYSTEMS APPROACH).
- What one does is a reflection of what one believes and what one knows. Education therefore should be based on concurrent development of "being able to do", "being able to think" and "being able to make judgements based on feelings and attitudes" (CONFLUENT EDUCATION).
- Problem solving abilities differ according to the level or complexity of the problem involved — a good problem solver is not only aware of the level of problem situation being faced but can use solving or improving techniques appropriate to the particular situation (a CONTINGENCY APPROACH to management and technology).
- Learners invariably progress through noticeable phases of behaviour in any learning experience and different phases need different types of "teacher assistance" or facilitation.

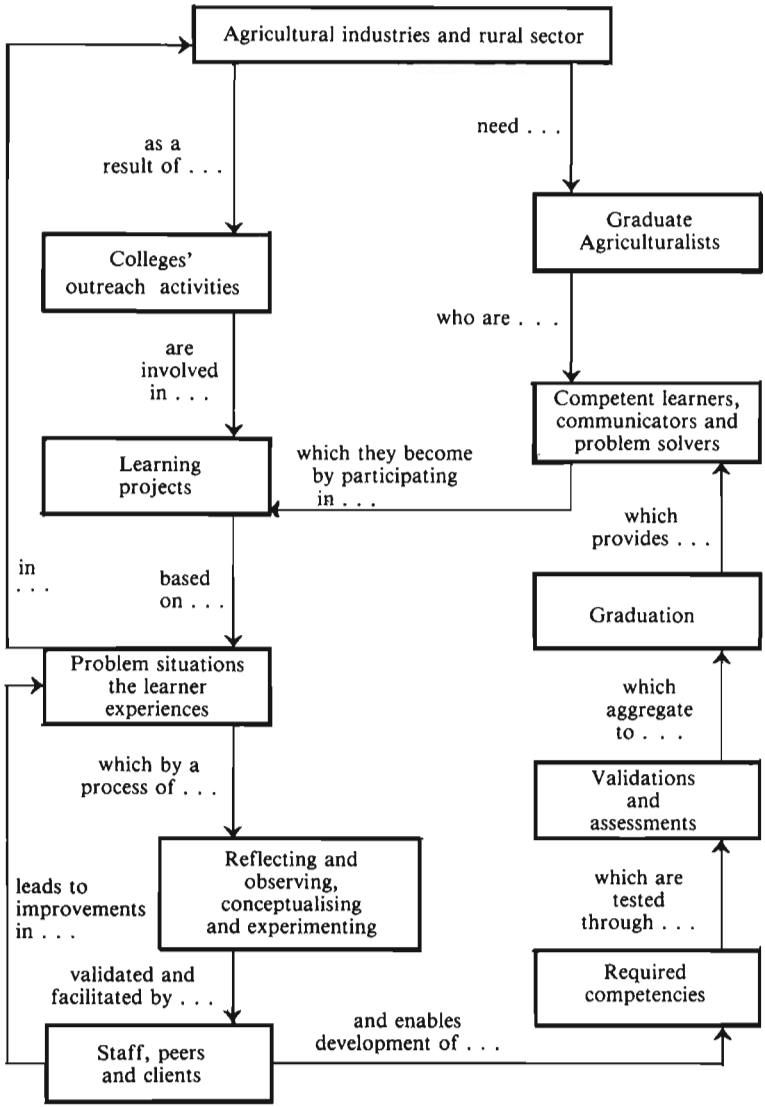
This view of the learner, or problem solver, as one active in thinking and doing things about life situations closely reflects the educational philosophies of such writers as Rogers[10], Tough[11], Freire[12], Illich[13], Knowles[14], Burgess[15] and Kolb *et al.*[16]

## THE NATURE OF THE CHANGE

The strategy that has emerged as a response to the challenge is illustrated in Figure I. The inference from this model is that those in the rural industries, those preparing to enter them as graduates, and staff at the institution, are interdependent learners and problem solvers. The School becomes an open resource or subsystem within the broader system of agriculture and as the latter is operating in a dynamic environment, so too must the former. This perspective is far

## FIGURE I

**Programme design and the interaction between the needs of agriculture and the rural sector, education of graduates to meet the need, and the experiential learning process**



removed from the time honoured one of teacher-oriented, discipline based studies which Lees and his colleagues concluded was dominating agricultural education.[17]

The basic competencies required of a professional agriculturalist have been identified at Hawkesbury as effective communication, autonomy in learning, problem solving and situation improving abilities. Development of these competencies is the focus of the programmes. This is done through a process of experiential learning based on students' investigations of problem situations in agricultural industries and the rural sector. A semester spent in appropriate off-campus settings, usually a co-operator's farm, is a feature of all the programmes. The problem situations encountered are the origin of many of the projects on which students and staff subsequently work.

## THE CONCEPTUAL MODEL

Figure II is a conceptual model of "a system to educate systems agriculturalists in an institution where past experience has been with a didactic and reductionist approach to the education of agricultural technologists". The model is based on reflections and observations of the experience at Hawkesbury over the past seven years.

The four major subsystems of the model reflect functions that are seen as essential whilst the linkages provide the rationale for their sequence. The distinguishing characteristic of this style of conceptual modelling is the emphasis on functions and processes rather than on the structures and components of the system under investigation. This particular modelling technique was developed experientially at Lancaster University in the U.K. by Peter Checkland and his colleagues.[18] The conceptual model provides a context for observations about the experience at Hawkesbury.

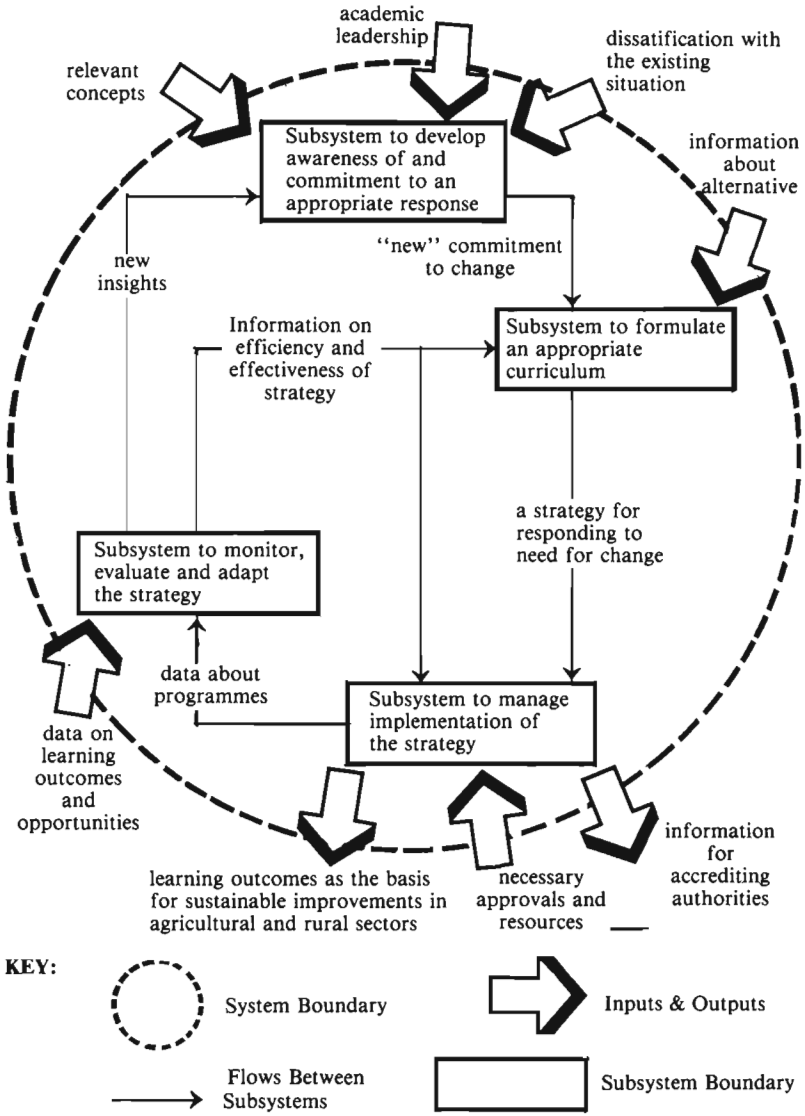
### *Developing an Awareness of and Commitment to an Appropriate Response*

The sense of unease among staff and others with an interest in the programs at Hawkesbury was fundamental. There was a feeling that the programs that had been introduced in 1972 were no longer appropriate but attempts to develop alternatives were leading to high levels of frustration.

Given this situation there were two essential inputs. One was academic leadership and the other a coherent set of concepts which people in the situation saw as relevant. The new Head of School played a key role in both of these areas. After his appointment in 1978 he was instrumental in developing and articulating an educational philosophy which discriminated between holism and reductionism,

**FIGURE II**

**A conceptual model of a system to educate systems agriculturalists in an institution where past experience has been with a reductionist and didactic approach**



science and technology, teaching and learning.[19] He was able to relate this to the need for a "new breed of agriculturalist" — a graduate who took an holistic approach to the social and economic as well as the production aspects of agriculture.[20] The result was a vision, at that stage vaguely defined, of the sort of graduate that could be produced and the programs that would do it.

*Formulating an Appropriate Curriculum*

The process of experiential learning as conceived by Kolb and his colleagues explains the process by which the commitment to change was transformed into a strategy for responding to the need that prompted the change.[21] The decision to change was made and we learned from subsequent experience. As each year passed the conceptual framework became richer and clearer, the need for changes in programs and management to gain greater consistency were highlighted and desirable alternatives became more obvious.

Key elements in the process have been:

- Developing a clear and widely understood and accepted statement of purpose for the School.
- Developing a basic conceptual framework that integrates concepts about learning outcomes and activities and is consistent with the purpose.
- Appreciating that the School must be an open system in which there is maximum transfer of energy, ideas and support within the School and between the School and the external environment.
- Developing an appreciation of situational factors that will have to be taken into account if the School is to be workable — such as the roles staff will have to play, the climate that will have to be established if the learning processes are to operate, an organisational structure that is consistent with the required processes and appointment of appropriate staff to key leadership positions.
- Appreciating the resources that will be required to implement the new programs.

*Managing Implementation of the Strategy*

A concept of management that we have found useful is that of Kast and Rosenzweig.[22] They see management as an integrated process operating at three levels — *strategic planning,* where the prime aim is to relate the organisation to the external environment; *allocating,* where the aim is to coordinate activities and allocate resources; and

*operating* the programs that relate the organisation to its environment. The aim is to get a consistent approach between these levels. The change process at Hawkesbury was an organic one based on experiential learning with anomalies between levels numerous and the resultant stresses considerable. Initially there was uncertainty about procedures that would be needed to make the newly accredited programs operational. When appropriate operational procedures were developed the firmly entrenched system for coordinating activities and allocating resources, which was based on the programs of the past, was found to be inhibiting efficiency and effectiveness.

One of the features of the Hawkesbury experience was that, in the main, the staff who conducted the old programs were now operating programs that were radically different. While the old programs were being phased out and the new in, they were running both concurrently. That they managed to do so is a tribute to their adaptability rather than any planned process of staff development. A realisation that the changes were both fundamental and permanent was a key factor in this process. Once staff realised the process was irreversible they committed themselves to adapting to and managing the change process. There were varying levels of understanding and acceptance of the new approach but there has always been a "critical mass" of staff support. The leadership process during this period was of the functional variety where individuals took initiatives in response to needs they identified.

A key element in the design of the new programs is that they and the structure within which they operate be "open systems" with maximum transfer of energy and ideas between them and the external environment. Without this openness it would have been even more difficult for staff to change their role from teaching to facilitating learning. The inputs that came from agencies and individuals outside the School was both essential and readily forthcoming. The widespread interest among agricultural educators in Australia and overseas helped to sustain commitment.

Openness to the agricultural community is a basic tenet of the programs. Farmers have responded well to this and there is now a databank on 1,200 farmers interested in taking a student for a semester of farm experience.

### *Monitoring, Evaluating and Adapting the Strategy*

Most staff energy since 1981, when the School's biggest program began, has gone into experiential learning associated with the design and conduct of programs, and this one in particular. In retrospect there is a recognisable pattern in which lessons learned have been incorporated into the design of the newest phase of the program while

earlier phases were only slightly modified. The end result was a mixed strategy in which the first year of the program and to a lesser extent, the second year, were based on a teaching strategy (although not perceived as such when originally designed) while third and fourth year were based on a learning strategy. In 1985 the design and conduct of the program was overhauled to get a consistent learning strategy in all phases. This has resulted in major changes in first year but only minor ones in fourth year. Lessons learned in this process are being incorporated into reviews of other undergraduate and postgraduate programs.

It was not until late in 1984 that a process of defining essential functions and allocating staff responsibility and accountability for them began. This process of defining functions and allocating responsibility and accountability is part of a process of structural reorganisation which began as an identifiable project during 1983 and culminated in a collective decision of the School in December 1984 to restructure. The College Council has subsequently given the School approval to experiment with the new structure during 1985 as a prelude to its deciding on a structure for the College as a whole for 1986.

The relatively recent focus on organisational issues is a reflection of the energy needed to design and conduct the programs, there being little left for anything else, and the realisation that organisational constraints were having an adverse effect on the programs. The restructuring project is a good example of action research because there were two clear aims:

(a) improving the problem situation; and,

(b) validating as part of a heirarchy of problem solving methodologies the particular methodology that was used to guide the process.

Checkland's concept of organisational climate being a function of the consistency between structure, function and purpose was a key one in arriving at a useful definition of the problem situation.[23] By 1983 there was a widespread sense of frustration with a perceived lack of efficiency and an apparent inability to remedy this. It was only as a result of a systems analysis of the School during 1983/84 that the lack of efficiency was seen as stemming from a basic incompatibility between the functions needed to support programs and an organisational structure whose origin was in the pre-1978 programs.

The systems methodology that was used in this project has as a basic feature a debate about desirable and feasible change based on the systems analysis and among the people affected.[24] This occurred in the School in the period August to November 1984 and a near unanimous

set of resolutions were passed by the School Board of Studies in December 1984. One of the features of the debate was the need to get a clearly defined and understood statement of the purpose of the School. The change process was an interactive search for consistency and a significant learning process for all involved. The need to consider the situation in an holistic way was facilitated by the conceptual models that were a feature of the systems analysis.

## CONCLUSION

The clarity of the learning paradigm emerging from participatory action amongst the staff and students is both a product of and a contributor to the magnitude of the change. Use of the paradigm has led to changes in the stated purposes of the School, in the various undergraduate and graduate curricula, in the conduct of its consulting, research and outreach activities and in its organisational structure.

Crucial to these developments has been awareness of the experiential learning process. Staff have been prepared to explore problems in the learning environment, conceive and model alternatives, identify desirable and feasible changes, take appropriate action and evaluate the outcomes. In doing so they have acted as role models for students. Methodology consistent with this view of the learning process has been a guide to, and a product of, the change process.

## NOTES AND REFERENCES

1. R.N. Farquhar, 'Agricultural education in Australia', Australian Council for Education Research, Melbourne, 1966; J.S. Nalson, *Consensus and Conflict in Agricultural Education,* University of Queensland Press, St. Lucia, 1973; H.S. Hawkins, E.F. Almond and M.G. Dwyer, 'Post-secondary educational needs of Australian farmers', School of Agriculture & Forestry, University of Melbourne, 1974; J.W. Lees, G.D. Da Roza and E.M. Carey, 'Competence and curriculum : a study of the national agricultural education system', Australian Rural Adjustment Unit, University of New England, Armidale, 1982.
2. F.M. Kelleher, 'Agricultural education : post-secondary programmes in Australia', Hawkesbury Agricultural College, Richmond, 1979.
3. Nalson, *op. cit.*
4. Lees *et al., op. cit.*
5. R.J. Bawden, R.D. Macadam, R.G. Packham and I. Valentine, 'Systems thinking and practices in the education of agriculturalists', *Agricultural Systems,* 13, 1984, pp. 205-25; R.J. Bawden and I. Valentine, 'Learning to be a systems agriculturalist', *Programmed Learning & Educational Technology,* 21, 1984, pp. 273-87.

6. A.M. Anderson, 'How advisers advise', Department of Extension, School of Management & Human Development, Hawkesbury Agricultural College, Richmond, 1979; A.M. Anderson, 'Farmers' expectations & use of agricultural extension services', Department of Communication, School of Management & Human Development, Hawkesbury Agricultural College, Richmond, 1981; A.M. Anderson, 'Processes and implications of knowledge transmission in Australian agricultural extension', Department of Communication, School of Management & Human Development, Hawkesbury Agricultural College, Richmond, 1982.
7. D. Kohlhoff and R. Macadam, 'Report on college goals workshop', Hawkesbury Agricultural College, Richmond, 1976.
8. C.E. Engels and R.M. Clarke, 'Medical education with a difference', *Programmed Learning and Educational Technology,* 16, 1979, pp. 14-42.
9. J.L. Dillon, 'The economics of systems research', *Agricultural Systems,* 1, 1976, pp. 5-22; C.R.W. Spedding, *An Introduction to Agricultural Systems,* Applied Science Publishers, 1979.
10. C.R. Rogers, *Freedom to Learn,* Charles Merrill, Columbus, Ohio, 1969.
11. A. Tough, 'The adult's learning project : a fresh approach to learning', Research in Education Series No. 1, Toronto, The Ontario Institute for Studies in Education, 1971.
12. P. Freire, *Pedagogy of the Oppressed,* Sheed & Ward, London, 1972.
13. I. Illich, *Tools for Conviviality,* Harper & Row, New York, 1973.
14. M.S. Knowles, *Self-directed Learning : A Guide for Learners & Teachers,* Associated Press, New York, 1975.
15. T. Burgess, *Education After School,* Victor Gollancz, 1977.
16. D.A. Kolb, T.M. Rubin and J.M. McIntyre, *Organisational Psychology : An Experiential Approach,* 3rd Edition, Prentice Hall, 1979.
17. Lees *et al., op. cit.*
18. P. Checkland, *Systems Thinking : Systems Practice,* John Wiley, 1981.
19. Bawden *et al., op. cit.*
20. Bawden and Valentine, *op. cit.*
21. Kolb *et al., op. cit.*
22. F.E. Kast and J.E. Rosenzweig, *Organisation and Management,* 3rd Edition, McGraw Hill, 1981.
23. Checkland, *op. cit.*
24. *ibid.*