

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/228346884>

Becoming an Agroecologist through Action Education

Article in *International Journal of Agricultural Sustainability* · January 2004

DOI: 10.1080/14735903.2004.9684574

CITATIONS

82

READS

1,434

3 authors:



Geir Lieblein

Norwegian University of Life Sciences (NMBU)

58 PUBLICATIONS 2,911 CITATIONS

[SEE PROFILE](#)



Edvin Østergaard

Norwegian University of Life Sciences (NMBU)

26 PUBLICATIONS 466 CITATIONS

[SEE PROFILE](#)



Charles A Francis

University of Nebraska at Lincoln

368 PUBLICATIONS 10,444 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Cultivating Public Spaces: urban agriculture as a basis for human flourishing and sustainability transition in Norwegian cities [View project](#)



Carbon Sequestration Project [View project](#)

Becoming an Agroecologist through Action Education¹

Geir Lieblein¹, Edvin Østergaard² and Charles Francis³

¹Department of Plant and Environmental Sciences, Norwegian University of Life Sciences/UMB, PO Box 5003, 1432 Ås, Norway; ²Department of Mathematical Sciences and Technology, Norwegian University of Life Sciences/UMB, PO Box 5003, 1432 Ås, Norway; ³Department of Agronomy & Horticulture, University of Nebraska, Lincoln, NE 68583-0915, USA

Action education provides an appropriate set of methods for learning about the complexities of farming and food systems. Agroecology provides the framework to organise learning opportunities for students interested in solving challenges in today's world. Our programmes in agroecology concentrate on discovery and learning. Rather than agroecological theory having primary value, we immerse students in practical phenomena at the farming and food system level, and let these phenomena determine what theory is necessary and relevant. Teachers are converted from lecturers to leaders and catalysts in the learning process. In a learning landscape on campus, on farms, and in communities, we find direction by focusing on how students can become agroecologists. Students will have knowledge of farming and food systems, and the skills necessary to handle complexity and change, to link theory to real life situations, to communicate and facilitate in an effective way, and to be autonomous in their learning. Agroecology and sustainable agriculture are good places for training in these skills. Such skills will be vital for graduates to proactively deal with the challenges of specialisation, high technology, and use of non-renewable resources in modern society, in the quest for strategy to achieve sustainable development.

Keywords action learning, agricultural professionals, agroecologist, experiential learning, systems education, visionary thinking

Introduction

Education in agroecology (Francis *et al.*, 2003), agricultural systems and sustainable agriculture can provide students with a broad curriculum that deals with the interaction among production, economic, environmental, and social dimensions of farming and food systems. Courses in agroecology and organic farming are becoming

more prevalent on university campuses in the Nordic region, Europe, US, and elsewhere (Srisankarajah *et al.*, 2005). Yet we observe that in most programmes and courses the teaching methods have departed little from a strong emphasis on transmitting information through lectures, some discussion and library readings, and periodic trips to farms that often turn into lectures in the field.

The predominance of lectures and narrowly focused courses are used in many agriculture and food system curricula as an accepted and even expected approach to education that fits into the comfort zones of both teacher and student. The majority of university teachers are specialists in research disciplines in science where they did graduate study, and few have experienced formal courses in educational history and theory. They are unfamiliar with the tenets of John Dewey's admonition that learning should not be authoritarian, but should begin with the experience of the individual students (Dewey, 1916).

Even teachers in agriculture who are not versed in the education literature will identify with Mezirow's (2000) thesis that the way in which we build understanding around a specific context often reflects our initial assumptions. We have more difficulty dealing with his conclusion that there are no fixed truths nor definitive knowledge, though a growing appreciation of the complexity of farming and food systems is leading us as agricultural scientists in that direction. Mezirow's transformation theory helps us understand how important it is to become aware of our assumptions and expectations, and to adjust those to the students or farmers we work with in the educational arena. Mezirow emphasised the need to critically reflect on the

assumptions and beliefs that shape practice, and propose that such reflection can transform our knowledge. We can then appreciate how these assumptions can filter our experiences as well as our awareness and understanding of what we observe, much as Kuhn (1962) describes the adherence to a dominant paradigm in each field of study.

Boud *et al.* (1993) emphasise the importance of how learning occurs in many places, and how this shapes our total experience and our lives. We learn to deal with complexities of systems, our own and others' personal commitments, and the emotions and feelings that help shape each 'learning landscape'. In line with John Dewey, Boud and colleagues emphasise that (1) experience is the foundation for learning, (2) learners actively construct their experience, (3) the process is inherently holistic, (4) learning is socially and culturally constructed, and (5) the entire educational process is strongly influenced by the socio-emotional context in which it occurs.

We have taken these lessons to heart in design of the Nordic region programme in Agroecology (Francis *et al.*, 2001; Lieblein *et al.*, 1999, 2000a, 2000b) and an Agroecosystems Analysis course in the US Midwest (Wiedenhoft *et al.*, 2003) that both feature action and participation-based learning. An allied term used for education that moves students onto the farm and into the community to deal with people and challenges in real-life situations is 'service learning' (Benson & Harkavy, 2000; Pollack, 1999), where students go beyond observation and become proactive in community change.

In the Nordic and Midwest programmes, teachers and students share the responsibility for learning. Faculty act as guides or learning leaders to organise an educational environment or 'learning landscape' where it is conducive and safe to explore and discover. The field is broadened from focus on the teacher to also encompass the students and their experiences. Maximum attention is placed on the process of learning, or learning how to learn, rather than on the specific content that is transitory and often outdated by the time it reaches the classroom. In addition to the knowledge goals that are the focus of most university programmes, we bring attention to the skills and attitudes that people have toward the material, and to their potential for visioning into the future. Our primary goal is to nurture the development of autonomous graduates who are prepared to

deal with complexity and change, rather than continuing to focus on the curriculum and on what we can prepare and present in the confines of the classroom. As organisers of this learning landscape, we can prepare the next generation of agroecologists to deal effectively with a rapidly changing and undefined future.

In this article we use action learning in its broadest sense: learning through action (McGill & Beaty, 2001). Action learning draws upon the works of Reg Revans (1998), who coined the term, as well as on experiential learning (Dewey, 1916; Kolb, 1984) and critical reflection (Mezirow, 2000). Through action learning, students and teachers learn with and from each other by working together to improve real situations, and by reflecting on their own experiences (McGill & Beaty, 2001).

From Teaching to Learning

One important reason for students to come to the university is to learn something they did not know. There are many dedicated teachers with broad appreciation of what is important, yet some topics may be chosen because they are the research specialties of teachers with narrow research or personal interests. We generally call ourselves teachers, and we really focus on doing teaching very well. Every university has teaching appointments, teaching evaluations, and teaching awards. There is an implicit assumption that when we teach, someone will learn. In fact some of us have learned the importance of agroecology and the whole farm and food systems from within the conventional educational structures, and integrated this with unique experiences achieved by farmers and others in the world outside academia.

Our Nordic and Midwest agroecology groups strongly believe that we can make more progress through an explicit focus on students and on their learning rather than by fine-tuning classroom methods or the improved organisation of a curriculum to fit our time-honoured beliefs in the importance of a certain list of basic and applied courses. This shift is in accordance with the direction of current pedagogical discourses and didactical thinking (Bawden *et al.*, 2000; McGill & Beaty, 2001).

'Just in time education' is a concept that we are exploring for the sequencing of courses in the

university curriculum (Salomonsson *et al.*, 2005). Instructors and advisors in the Swedish Agricultural University observed that many students were postponing a required first-year chemistry class until their fourth or even fifth year of study. Careful questioning of students about why they made this decision revealed that many were unsure of how and why they were studying chemistry, except that it was a requirement. Other students were ready for the course in their first year, but many did not understand the context nor had they experienced the need for that information. During their fourth or fifth years, these latter students realised the need for such a course, and it was 'just in time' for them to take it at this stage. When the focus is on learning, we provide opportunities for students to enrol in courses that they find the most purposeful. This does not eliminate the need for thoughtful advising by teachers, who can guide students through the learning landscape to find those courses that will best help them gain the experience and skills that they will need to meet their individual long-term objectives.

Focus on Action Learning

Learning through action and for action is a perspective which is drawn out of Dewey's experience-based learning. According to Dewey, education and upbringing of children is life, and life itself is human growth and development: 'Since growth is the characteristic of life, education is all one with growing; it has no end beyond itself' (Dewey, 1916). His basic idea, learning by doing *and* reflecting, points at our experiences and activities in the world as starting points for learning. Reflective practice, which is so important for professional development, is however not an automatic result of experience, since doing does not necessarily lead to learning. It is then the task of the teacher to intentionally facilitate for a situation where learning based on lived experience can take place (van Manen, 1990). It is the task of the teacher to create a genuine situation for experience, which means that the learning of theoretical knowledge has to build on the students' own experience.

The basic principle of action learning is that learning and acting in the world is one and the same thing. As Argyris and Schön (1974: 4) state, 'all human beings, not only professional

practitioners, need to become competent in taking action and simultaneously reflect on this action to learn from it'. Learning is thus a process of reflecting on actions in the world, as they appear in one's own experience. In recent years several other pedagogical methods have risen from these basic ideas of Dewey, as experiential learning (Bawden *et al.*, 2000; Kolb, 1984) and problem based learning (Barrows, 1985, 1986). According to situated learning (Lave & Wenger, 1990), learning as it normally occurs is a function of the activity, context and culture in which it is situated. The theory of situated learning states that in order to achieve a good learning situation, knowledge needs to be present in a socially and culturally authentic context.

In accordance with the findings of Pfeffer (1998), we have observed over many years of dealing with students in the university that there is often a larger gap between knowledge and action than there is between ignorance and knowledge. This is not to endorse ignorance nor to minimise the importance of students expanding their knowledge base, but rather to achieve a compromise that shifts the balance away from total reliance on gaining knowledge to a new balance that puts emphasis on applications. Students may have knowledge and skills, but not an understanding of how to apply the knowledge to real life situations. Most education programmes are designed to add more knowledge and a few specialised skills to what students have already acquired from prior schooling. To be sure, it is important to know how to take soil samples or to recognise weeds in the field, as well as understand how to translate soil analyses or weed counts into recommendations for soil fertility additives or methods of weed control. But we find that this is not sufficient.

Bringing to attention attitudes toward the environment, and the rural clients with whom we work, is essential in putting knowledge to work. As teachers we obviously display our values, our attitudes, and our passions about certain topics to the students, and this is one of the joys of teaching. But this is quite different than only teaching about our own attitudes or forcing a specific point of view. Rather it demonstrates the importance of recognising attitudes and values as part of education and it is therefore essential for each student to examine their own. This step can bring them closer to action, because they experience that actions made to better the human situation are necessarily

grounded in values and attitudes, and that their own actions have a similar grounding.

Another important dimension of education is learning the power of visioning. In the quest for sustainable development, it is not enough to have knowledge and abilities to review the past and analyse the present. In addition, it is vital to have competencies in designing the future. Visionary thinking has a key role in building future oriented competencies. In accordance with Parker (1990: 1–2), we see visions as:

powerful mental images of what we want to create in the future. They reflect what we care about the most, and are harmonious with our values and sense of purpose. Visions are the product of insight, values and imagination, they are the head and the heart working together.

According to Senge (1990), shared vision at its simplest level is the answer to the question, 'What do we want to create?' Visionary thinking, introduced through a three-day seminar for the MSc students, has played a key role in our agroecological education at the Norwegian University for Life Sciences over the past six years. Students value this approach, since developing a coherent view of a potential and desirable future enables them to integrate their diverse case experiences. It also allows them to use the creative sides of their personalities, establishing a bridge from analysing the past and present to start thinking about actions to move from the present to the future desired situation (Lieblein *et al.*, 2001b).

Key Characteristics of Agroecological Education

Real life phenomena as the foundation for learning

In contrast to a conventional course where the first lecture describes the history and foundation of that discipline, in the agroecology courses real life phenomena are established as the starting point for the learning process. Rather than agroecological theory having primary value, we immerse students in practical phenomena at the farming and food system levels, and let these phenomena determine what theory is necessary and relevant. We place high value on incorporating students' lived experiences (van Manen, 1990), and reject the mystification of the experiences of everyday life. We think that real life

phenomena provide the necessary foundation for inter- and trans-disciplinary activities, because they provide a common language between and among the traditional disciplines. Inductive learning is therefore the preferred basic mode of learning. Agroecology as such is not only a specific body of theory, but it also involves a meaningful way of dealing with complex phenomena in farming and food systems, with the goal to improve those systems. Through such an understanding of agroecology, its two related dimensions become clear: agroecology as a set of theories and as a set of abilities.

Inclusion of divergent modes of learning

We further explicitly introduce the divergent mode of thinking and sharing experience early in the learning process. The process of convergence has been over-emphasised as an analytical approach within academia, as opposed to a more innovative, divergent, and unstructured mode of thinking and creating meaning. The balance between these two modes of thinking needs to be restored, and the interface between the two needs to be encouraged and expanded. In line with this we critically and creatively need to consider the whole range of possible pedagogical interventions to be able to meet the diverse needs of students, who come with different learning styles and different personal and cultural experiences.

Students as the focus of education

One key principle in our planning and implementing the agroecology courses is that the student is placed in the centre of the activities. In other words, rather than looking at agroecology as a subject matter or discipline, we are concerned about the agroecologist. Thus, the primary goal is not to understand or analyse the agroecosystem, but rather to develop oneself as someone who puts agroecology into practice. More than a discussion about what is the necessary theory to cover is the exploration of what knowledge, skills, attitudes, and capacities for visioning we consider important for the agroecologist to have to become an agent of change for sustainable development.

Explicit recognition of student contributions

In line with placing the student in the centre of the programme, we are geared towards learning

activities that celebrate and build on contributions from individual students. In this process, 'the inside of the individual is brought out,' rather than a one-way information transmission that assumes that the mind of the student is an empty vessel to be filled with theory, 'bringing the outside in'. We see this as an important prerequisite for developing the proactive capacities of students, to enable them to become agents of change. Examples of activities in the courses to build these skills are developing rich pictures of complex situations, mind mapping, dialogue, creative problem solving, and visionary thinking. These are all activities driven by students and guided by teachers.

New Roles in Education

Systems and action oriented learning implies new roles for all involved in the education of agroecologists. As already stated, the main challenge is to link the subject matter of agroecology, with its interdisciplinary and holistic character, to the students' learning. Our approach, in accordance with action learning and experiential learning, has been to start with the experiences of the students, but not in a fundamentalist sense. As such we see the merging interest in action learning as a reaction to the traditional teaching and theory-based education. This swings the pendulum to the opposite extreme from where the focus is on the theories of the teacher. This has been a necessary shift of focus in education, but the sole application of experiences as a basis for learning has its limitations, and if pursued too far it becomes fundamentalist. The problem is that not all learning is based on our experiences: we also learn from others in a social setting (Bandura, 1977), from the culture in which we are embedded (Lave & Wenger, 1990), but also from theory that may come through a good lecture or a good book. The challenge is to blend many different approaches to meet the needs of many different students. Also, in a strict phenomenological sense, the diversity of real life phenomena needs to be met by a diversity of learning modes. It has been important for us not to go completely from the traditional theory-based teaching to the new practice-based experiences in one large leap, but to widen the field of learning for the students. They should be able to go deep into theory and then deep into practice.

When the focus shifts from teacher to student all parties involved have to find their new roles within the educational system. Lieblein and Østergaard (2001a) have called this a 'pedagogy of no mercy', because the feedback becomes especially clear and explicit. The real challenge in a 'pedagogy of no mercy' is that changing from lecturing to improving the students' learning implies loosing the control of the learning situation. Through this process the teachers' role changes; the teachers still have the responsibility for the overall learning process, as learning leaders, but also become co-learners together with the students. The students are no longer receivers of knowledge, but have a new role as learners, and their learning involves more than cognition. What the students experience also involves notions, emotions, and attitudes. Their learning becomes competency oriented, involving knowledge, skills, attitudes, and potential for visioning. Their goals are no longer to uncover answers already known by the teachers or written in textbooks; instead, teachers and students will engage in a joint process to learn about complex real-life situations (Francis *et al.*, 2001). The shift from knowledge to competency orientation also implies the shift from a focus on agroecology to the process of becoming an agroecologist. The focus on knowledge is very often connected to the input-output model of knowledge transfer. The competency orientation must on the other hand be related to developing and improving skills through a mutual relation – between the students, between the students and the stakeholders 'out there' and between the students and the teachers.

In this process the roles of theory and practice also change: practice is no longer just used as an example of theories lectured in the classroom, but is used as the starting point for learning. And theory is no longer the focal part of the education, but is seen as something that should support the learners in their development.

Focus on Becoming an Agroecologist

Students embrace a certain field of study because they are motivated, hopefully even passionate, about learning new things and putting them into action. Whatever we do in designing the educational landscape should serve to promote and fulfil that passion, rather than stifling it. An example from classical medical

schools is appropriate. The conventional curriculum involved heavy first and second year courses in anatomy, learning the Latin names of hundreds of muscles and bones, and this often served as a screening tool to eliminate many who were not capable of, or interested in, such rote learning. Successful memorisers became the specialists who dominate today's medical profession. Some students dropped out because they were bored with material that was important, to be sure, but far from the contacts with real patients that they anticipated. The courses did not fulfill their desire to help people that generated their passion in the first place.

The University of Tromsø in Norway and the Oregon Health Sciences Hospital in the US pioneered the mentoring approach that put medical students into white coats with name badges and stethoscopes right from the first week in school. They took patient histories, made preliminary diagnoses, and shadowed mentor doctors for one day each week, thus reinforcing their passion for dealing with people in need. This new and practical approach prevented the unnecessary early screening out of some of the best future doctors with a strong social conscience who may not have been the top academic students based on memorising bones and muscle names. These potential future caring physicians often despaired of ever seeing patients, and it is likely that we have lost many candidates who could have become the best general practitioners. The new system seems to be working, and it is spreading to other medical schools.

So rather than focus on the time-honoured curriculum, continuing to teach courses in the sequence in which they have always been taught to all students, we should focus on what we want to achieve – a well prepared, knowledgeable, confident graduate in agroecology. We can focus on students and on learning, rather than on teachers and on teaching. We can design learning landscapes and environments that put the joy of discovery into learning, and can put shared responsibility for learning on teachers and students. The schedule and content of classes can include learning skills and new knowledge as well as clarification of attitudes toward the material and potential for visioning the future wanted situation (Schneider *et al.*, 2005).

The strategy described here for planning educational experiences in agroecology is completely

focused on who will complete the course of study, how they will put knowledge into action, and what they will do when they leave the programme. We call this action education. Students observe and evaluate, and join the faculty in visiting farms, interviewing farmers and families, and learning the broad context of the farm situation. The skilled agroecologists graduating from the programme will:

- Have knowledge of farming and food systems.
- Be able to handle complexity and change.
- Be able to link theory to real life situations.
- Be good communicators and facilitators.
- Be autonomous learners.

These competencies are not only vital for dealing with agroecological issues. They are key qualifications (Kämäräinen, 2002), which implies that they are transferable; the achieved skills are not limited to an agroecological context, but can be practiced in other parts of life. Agroecology and sustainable agriculture are good places for training these skills. Such skills will be vital to proactively deal with the challenges of specialisation, high technology, and use of non-renewable resources in modern society in the quest for a sustainable development.

Correspondence

Any correspondence should be directed to Dr. Geir Lieblein, Department of Plant and Environmental Sciences, Norwegian University of Life Sciences/UMB, PO Box 5003, 1432 Ås, Norway (geir.lieblein@umb.no).

Note

1. Published as College of Agricultural Science and Natural Resources, Journal No. 04–02, University of Nebraska.

References

- Argyris, C. and Schön, D.A. (1974) *Theory in Practice: Increasing Professional Effectiveness*. San Francisco: Jossey-Bass Publ.
- Bandura, A. (1977) *Social Learning Theory*. Englewoods Cliffs, NJ: Prentice Hall.
- Barrows, H.S. (1985) *How to Design a Problem-Based Curriculum for the Preclinical Years*. New York: Springer.
- Barrows, H.S. (1986) A taxonomy of problem-based learning methods. *Medical Education* 20, 481–486.

- Bawden, R.J., Packham, R., Macadam, R. and McKenzie, B. (2000) Back to the future: Reflections from Hawkesbury. In M. Cerf, D. Gibbon, B. Hubert, R. Ison, J. Jiggins, M. Paine, J. Proost and N. Röling (eds) *Cow up a Tree: Knowing and Learning for Change in Agriculture – Case Studies from Industrialised Countries*, Paris: INRA.
- Benson, L. and Harkavy, I. (2000) Integrating the American system of higher, secondary, and primary education to develop civic responsibility. In T. Erlich (ed.) *Civic Responsibility and Higher Education* (pp. 174–196). Phoenix: Oryx Press.
- Boud, D., Cohen, R. and Walker, D. (eds) (1993) *Using Learning Experience*. Berkshire, UK: Open University Press, McGraw-Hill.
- Dewey, J. (1916) *Democracy and Education*. New York: Macmillan.
- Francis, C.A., Lieblein, G., Helenius, H., Salomonsson, L., Olsen, H., and Porter, J. (2001) Challenges in designing ecological agriculture education: A Nordic perspective on change. *American Journal of Alternative Agriculture* 16 (2), 89–95.
- Francis, C., Lieblein, G., Gliessman, S., Breland, T.A., Creamer, N., Harwood, R., Salomonsson, L., Helenius, J., Rickerl, D., Salvador, R., Wiedenhoef, M., Simmons, S., Allen, P., Altieri, M., Flora, C. and Poincelot, R. (2003) Agroecology: The ecology of food systems. *Journal of Sustainable Agriculture* 22 (3), 99–118.
- Kolb, D. (1984) *Experiential Learning. Experience as the Source of Learning and Development*. New Jersey: Prentice-Hall.
- Kuhn, T.S. (1962) *The Structure of Scientific Revolutions* (3rd edn). Chicago, IL: University of Chicago Press.
- Kämäräinen, P., Attwell, G. and Brown, A. (eds) (2002) *Transformation of Learning in Education and Training: Key Qualifications Revisited* (Cedefop Reference Series; 37). Luxembourg: Office for Official Publications of the European Communities.
- Lave, J. and Wenger, E. (1990) *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press.
- Lieblein, G. and Østergaard, E. (2001a) Shifting focus – experiences from the first NOVA MSc in an agroecology. Dept. Horticulture and Crop Sciences, Program for Pedagogics, Agricultural University of Norway (NLH), Norway. 19 pp.
- Lieblein, G., Francis, C.A. and Torjusen, H. (2001b) Future interconnections among ecological farmers, processors, marketers, and consumers in Hedmark County, Norway: Creating shared vision. *Human Ecology Review* 8 (1), 61–72.
- Lieblein, G., Francis, C.A., Salomonsson, L. and Sriskandarajah, N. (1999) Ecological agriculture research: Increasing competence through PhD courses. *Journal of Agricultural Education and Extension* 6 (1), 31–46.
- Lieblein, G., Francis, C. and King, J. (2000a) Conceptual framework for structuring future agricultural colleges and universities. *Journal of Agricultural Education Extension* 6, 213–222.
- Lieblein, G., Francis, C., Barth Eide, W., Torjusen, H., Solberg, S., Salomonsson, L., Lund, V., Ekblad, G., Persson, P. Helenius, J., Loiva, M., Sepannen Kahiluoto, H., Porter, J., Olsen, H., Sriskandarajah, N., Mikk, M. and Flora, C. (2000b) Future education in ecological agriculture and food systems: A student-faculty evaluation and planning process. *Journal of Sustainable Agriculture* 16 (4), 49–69.
- McGill, I. and Beaty, L. (2001) *Action Learning*. London: Kogan Page.
- McKeachie, W. (1986) *Teaching Tips: A Guidebook for the Beginning College Teacher*. Boston, MA: D.C. Heath.
- Mezirow, J. (ed.) (2000) *Learning as Transformation: Critical Perspectives on a Theory in Progress*. San Francisco, CA: Jossey-Bass.
- Parker, M. (1990) *Creating Shared Vision*. Oak Park, IL: DIALOG International Ltd.
- Pfeffer, J. (1998) *The Human Equation: Building Profits by Putting People First*. Boston: Harvard Business School Press.
- Pollack, S. (1999) Early connections between service and education. In T.K. Stanton, D.E. Giles and N.I. Cruz (eds) *Service-Learning: A Movement's Pioneers Reflect on its Origins, Practice, and Future* (pp. 12–32). San Francisco: Jossey-Bass.
- Revans, R. (1998) *ABC of Action Learning*. London: Lemos and Crane.
- Senge, P.M. (1990) *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Doubleday.
- Salomonsson, L., Francis, C., Lieblein, G. and Furugren, B. (2005) Just in time education. *NACTA Journal* (in review).
- Schneider, M., Colglazier, A., Beutler, R., Pollard, C. and Francis, C. (2005) Discovering the whole: Multiple paths to systems learning. *NACTA Journal* (in press).
- Silberman, M. (1996) *Active learning: 101 Strategies to Teach Any Subject*. Boston, MA: Allyn and Bacon.
- Sriskandarajah, N., Francis, C., Salomonsson, L., Kahiluoto, H., Lieblein, G., Breland, T.A., Geber, U., and Helenius, J. (2005) Education and training in ecological agriculture: Nordic region and U.S.A. In A. Taji and P. Kristiansen (eds) *Organic Agriculture: A Global Perspective*. Collingwood, Victoria: CSIRO Publishing (in press).
- van Manen, M. (1990) *Researching Lived Experience. Human Science for an Action Sensitive Pedagogy*. New York: State University of New York Press.
- Wiedenhoef, M., Simmons, S., Salvador, R., McAndrews, G., Francis, C., King, J. and Hole, D. (2003) Agroecosystems analysis from the grass roots: A multidimensional experiential learning course. *Journal of Natural Resources and Life Science Education* 32, 73–79.