Educational Perspectives in Agroecology: Steps on a Dual Learning Ladder toward Responsible Action[1]

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Abstract

The Nordic Agroecology MSc program educates professionals to deal with complex challenges facing agriculture and food systems today and in the future. We strive for understanding multifunctionality, complexity, and uncertainty of performance of agroecosystems. Cognitive processes are seen as steps in an external learning ladder, where we break from the classical concept of always starting at the bottom rung for a one-way climb toward more advanced learning. Our students start in the middle, exploring real-life cases on farms and in food systems, and move up and down the ladder. They step down to train in routine skills and memorize factual and theoretical knowledge needed to deal with the real-life challenges, or step up for visioning and implementing improvements. We envision a corresponding ladder that describes internal, personal reflection on the course activities. This requires emotional involvement, clarification of ethics and personal values, and reflection on experiences. While the external ladder goes upwards toward more complex cognitive processes, the internal ladder goes downwards for a deepening of individual reflection as a practicing, assimilating, connecting, creating, and acting person. The focus on the agroecosystem phenomenon as experienced and linked to theory is balanced by the process of becoming an agroecologist. The dual learning ladder enables students to improve their understanding of agriculture and the wider food system and to practice reflection as basis for personal growth.

Introduction

Current challenges in agricultural colleges and universities include attracting quality students and providing relevant educational experiences that will strengthen their motivations and prepare them for a complex future. University programs in agriculture traditionally have focused on acquiring knowledge about agricultural production and food processing, plus the attendant marketing and policy issues. Theory is an essential part of education. However, experience from the Nordic Agroecology MSc program has shown that getting theoretical knowledge is only part of preparing students to enter agricultural professions. Focus of education needs to go beyond production, to include study of the functions of an intact rural landscape and the importance of people, families, and community, as emphasized by the National Research Council (2003). Graduates in agroecology need to function with autonomy, use team skills, and operate with authority and confidence in making decisions in this broad arena. In this paper, we explore the elements of a learning process and present a metaphor of a dual learning ladder lead that leads to responsible and directed action.

Rationale

Agriculture and food systems today are much more complex than a simple food chain that goes from place of production to table of the consumer. Farming areas function as a source of food and raw materials, but sustaining the food supply requires attention to ecological and social dimensions in addition to production and economics. Multifunctional rural landscapes are recognized for the important ecosystem services or functions on which humanity depends (Daily, 1997). Local food systems have potential to cycle resources back into these landscapes, promote direct sales that increase value in the local economy, contribute to long-term food security, maintain the

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cultural landscape, and reduce the distance between farmer and consumer. Francis et al. (2003a) defined agroecology as the ecology of food systems, providing a broad context in which to study production, processing, marketing, and food consumption. It is important to explore the complexity of food systems and push students beyond the current knowledge and experience base in the university, immersing them in a program that emphasizes competencies and desired learning outcomes to prepare them as agroecologists (Lieblein et al., 2005).

Bowden and Marton (1998) argue that focus should be on the capacity to become engaged in action. They conclude that this capacity comes from an ability to view the world in multiple ways and to evaluate different courses of action. Beyond learning skills, principles, and facts about agriculture, students need to learn the process of integrating disparate sources of information, how to apply these in the context of the farm and food system, and to develop their own ability to participate in responsible change (Lieblein et al., 2005).

To prepare for a complex and uncertain future, students need an education that will not go quickly out of date. Bowden and Masters (1993) insist that a generic knowledge is most valuable, and they refer to the student abilities developed by integrating knowledge from disciplines with other practical experience. It is within this context that we examine the relationship between a purely cognitive and a more personal dimension in education. In this paper, each of the elements of learning is discussed and their interrelationships are explored in a logical sequence of designing a just-in-time education (Salomonsson et al., 2005). Although design of the Nordic program has been based primarily on empirical experience in teaching MSc and PhD courses over the past decade (Lieblein et al., 1999; Francis et al., 2003b), the philosophy of the course organization and learning methods are based on the principles of democracy and action education as conceived by Dewey (1916) nearly a century ago.

Hierarchy in Learning: From Receptive to Autonomous

Numerous authors have explored the steps in learning and created a hierarchy of knowledge, often starting with Benjamin Bloom's (1956) taxonomy that goes from memorizing facts, through comprehension to application, analysis, synthesis, and evaluation. A practical "Cone of Learning" was used by Edgar Dale (1969) to explain why multiple methods of learning are essential for people to retain what is important. For example, reading a book results in 10% retention of information, seeing a demonstration increases this to 50%, while doing the real thing may reach 90% retention. Gregory Bateson (1979) explored what he called the ecology of the mind and based his theories on the perspective of "circular causal systems" rather than on "lineal, cause and effect thinking." This is appealing to ecologists who consider everything to be connected in nature, and to agroecologists who pursue the multiplicity of interactions among production, economics, environment, and society. Based on the work of Kurt Lewin, David Kolb (1984) described learning as a cycle that moves from concrete experience to reflective observation, abstract conceptualization, and active experimentation. In this paper we build on Bloom's concept of a learning ladder and Kolb's emphasis on linking cognition and practice. On this basis we present and explore a dual learning ladder metaphor that integrates a personal dimension including values, attitudes, and emotions into the learning landscape, in addition to cognitive elements.

Overview of Agroecology MSc Program

Based on the notion that students need a practical context and that they learn best by doing, we begin our agroecology courses on the farm and in the food system. In the field, we pursue the goal of fostering individual ways of seeing while at the same time promoting learning as a student/faculty community and operating in a common context. After making individual observations and immersing in group experiences, students explore the generic features of agroecosystems, methodological approaches from natural and social sciences, and the links between practice and theory.

In this practical context, our agroecology students practice questioning, to successfully search out relevant answers that are location and time specific, and to envision what a desirable future would look like. They must be prepared to read the situation, identify and prioritize issues, envision solutions, and plan for responsible action. One useful strategy is to help students seek new applications for the skills and knowledge already learned, affirming and building on their prior experiences. More closely aligning our study programs to address issues that have priority in contemporary society not only improves the relevance and quality of the learning outcomes but also stimulates and maintains potential student interest. This approach is helping us attract motivated people to study agroecology, and to counter the current trend toward lower numbers of applications of qualified students.

A Cognitive Learning Ladder in Agroecology

Our learning programs build on the theoretical studies described above, and often we refer to them in class while exploring the complexity of organization of production and food systems. In line with Bloom (1956) we perceive of learning as a pragmatic series of interacting activities or steps as illustrated in Figure 1. The steps could be envisioned as an external learning ladder, because it focuses on knowledge about the

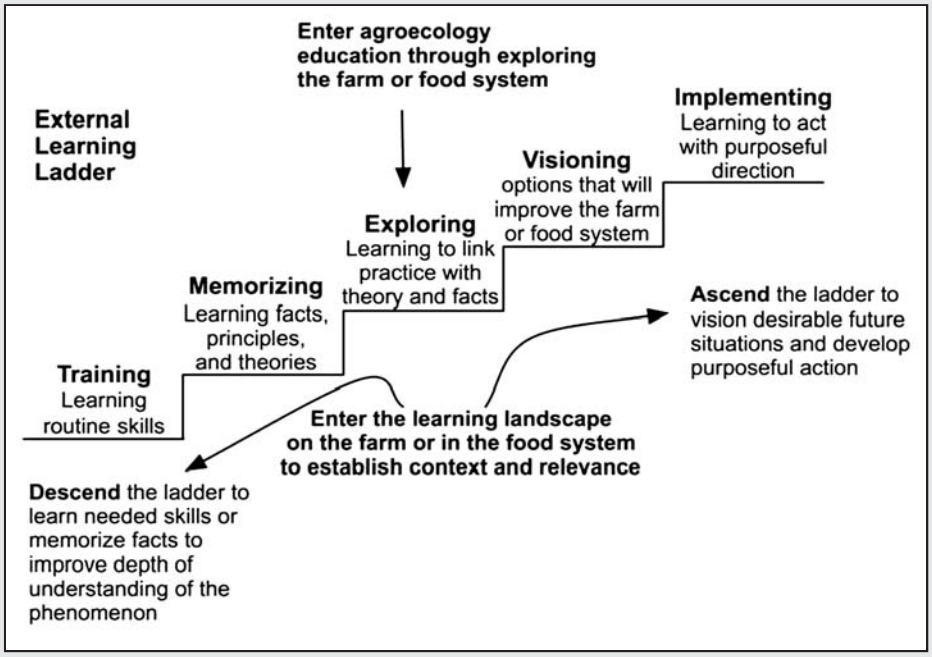

Figure 1. Structure of the learning process: steps in the external learning ladder with specific content in learning: routine skills, theory and facts, linking practice with theory, visioning future scenarios, and directed action in the educational process.

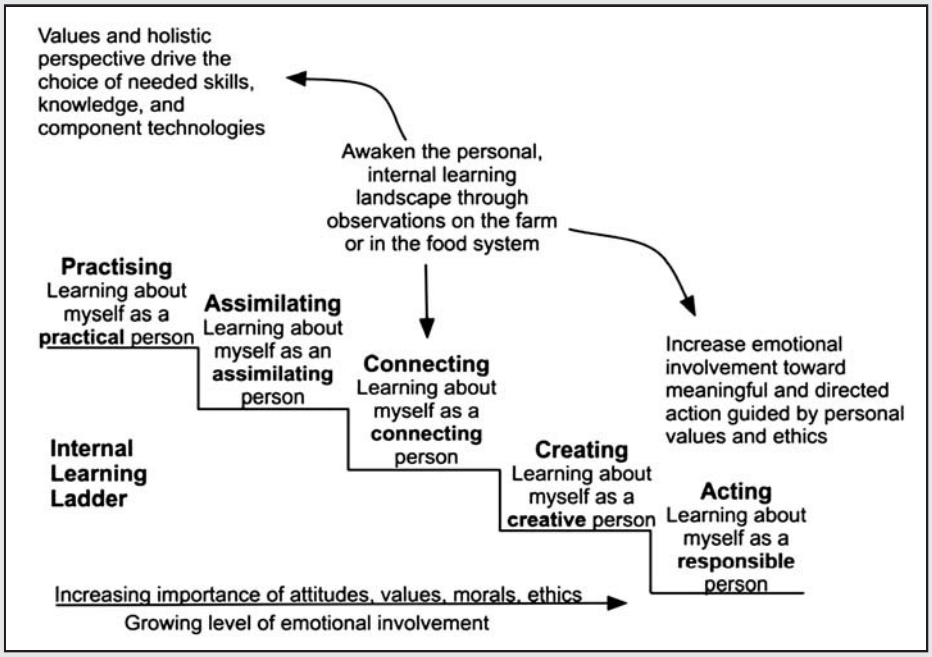

Figure 2. Expansion to include the personal learning process: upper steps in the internal learning ladder with increasing importance of attitudes, values, morals, and ethics toward the phenomenon, growing emotional involvement, and how these lead to purposeful and responsible action though individual learning and growth.

phenomenon in the world out there, dealt with by the students. The external ladder has a strong emphasis on cognition (Bloom 1956), but also incorporates the connections between cognition and action, as developed by Kolb (1984). When applied to learning in agroecology, the process could be envisioned as a number of steps on a ladder that illustrates the activities in which students engage: (1) training to learn routine skills; (2) memorizing, accumulating and clarifying principles, theories, and facts; (3) exploring or learning to link theory and facts with practice in the field; (4) visioning alternative futures or options that are more desirable, based on capacities developed in the first three steps, and designed in cooperation with clients in the field; and (5) implementing action, or learning to act with purpose and direction.

The lower steps on the ladder could be described as working in a known environment, where students must be reactive to the outside facts, skills, and information provided in classes and other experiences. The higher steps on the ladder could be seen as an unknown situation, where students use their skills and knowledge to become proactive, taking their experiences and competence out to identify options that could improve the farming or food system. After identifying alternatives that could help improve production or security of the food system, they can evaluate the potential impacts of these options and set the stage for purposeful action.

In contrast to conventional educational strategies that start with training and memorizing facts and principles, we start on the exploring step (see Figure 1), on the farm and in the food system. In a conventional education we often assume that one starts at the first or lowest step of a learning ladder and then progresses upwards. In the agroecological education program the students jump in at step three in the ladder. This is the level where the learner is immediately confronted with the phenomenon or the case in all its complexity. Students are immersed in the real-world context and must link their prior experience, knowledge, and theories with practice, especially what they observe

in the field. They can descend the ladder to acquire additional needed knowledge to better understand what they have confronted in the field. This provides a stronger basis for ascending the ladder to create desirable future scenarios and plans for action. Each of these steps is discussed in more detail in later sections.

A Ladder of Personal Insight and Growth in Agroecology

We observe in the agroecology program that an important part of the learning process builds on a foundation of personal attitudes and individual growth, including clarification and application of ethical and moral values. In this process students learn about themselves as practical persons, cognitive or assimilating persons, connecting persons, creating persons, and responsibly acting persons, as illustrated in Figure 2. With each step there is increasing importance of attitudes and values, and a growing level of emotional involvement, going deeper into the personal or "inner world" as shown. More explanation of each of these steps of the personal growth ladder is provided in later sections.

Another way of illustrating the different types of learning is to describe activities, examples, and types of questions that are most important at each step of the external learning ladder. They also have a basis in the types and intensity of involvement of personal attitudes and values that are most important at each step. In Figure 3, there are different learning activities, practical examples, and types of questions that are posed at each step. There is also a summary of how we learn about ourselves while moving through the learning landscape. These examples will be further explained. Parallel to the external ladder we enter at the connecting step (see Figure 2). The students can then, as on the external ladder, ascend or descend on the internal ladder, parallel to the iterative approach of Kolb's (1984) learning cycle.

Following the ladder metaphor, as students and faculty participate in the learning process, we link the external and internal worlds in new ways. The farther we move up the external ladder, the deeper we go into the inner world of learning about ourselves. In each dual step, the individual learns more about the world and its complexity, but also more about personal values and attitudes and connections to society and the environment. In the conventional learning environment, by comparison, the theories, principles, skills, and knowledge are brought from the outside into the learner. In agroecology we provide a proactive approach, where the perspective is decided by the case or the phenomenon or the situation, and the applications are site specific. The following sections describe each step of the dual learning ladder and provide practical examples and quotes from students who have experienced the Agroecology MSc program.

Step 1: Training: Learning Routine Skills

The lowest step in the learning ladder is training in the routine skills needed to be a credible agroecologist in the field (Figure 4). Certain specific skills in agronomy, soil science, pest management, and economics are essential to understanding how to conduct data collection in the laboratory and field and to process this information. For example, one challenge in ecological production systems is maintaining adequate soil fertility in a system that depends on green manure crops, rotations, and application of animal manure at correct rates and at an appropriate time in the rotation cycle. Although there are weedy species that can provide useful indications of soil fertility and quality, a laboratory analysis is often useful to confirm other sources of information and provide data to fine tune practices. The ability to take representative soil samples and correctly run them through a laboratory is a skill that can be acquired, and in essence we are teaching students to find answers to questions that are already well established. This could be called training. It does not mean that an agroecologist will spend

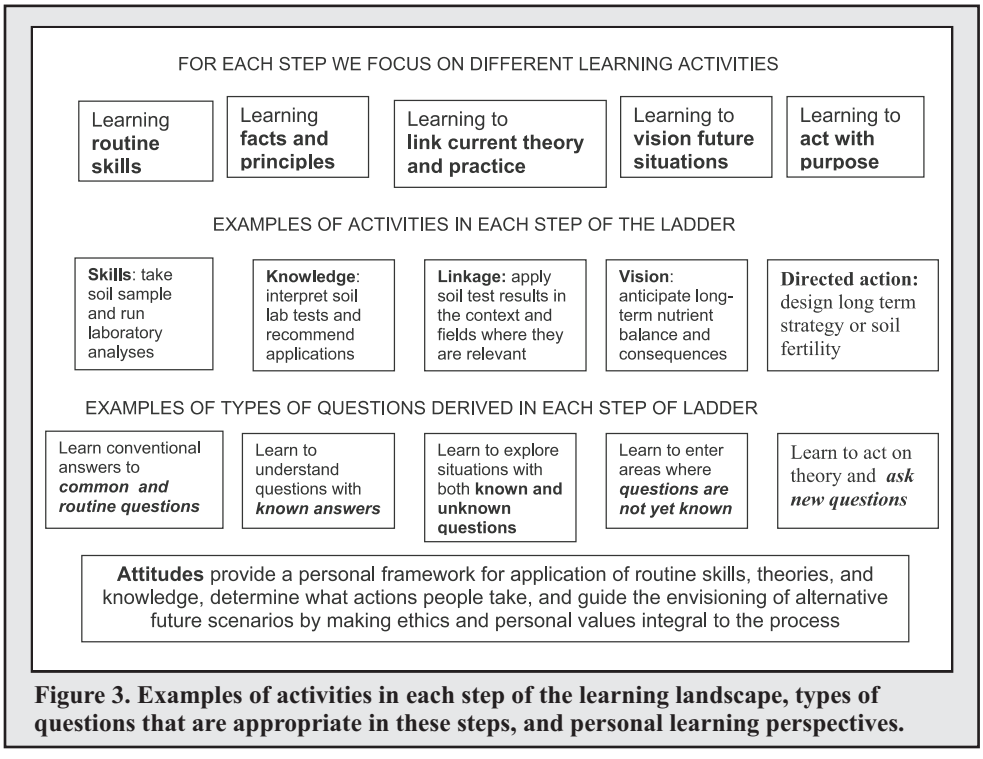

Figure 3. Examples of activities in each step of the learning landscape, types of questions that are appropriate in these steps, and personal learning perspectives.

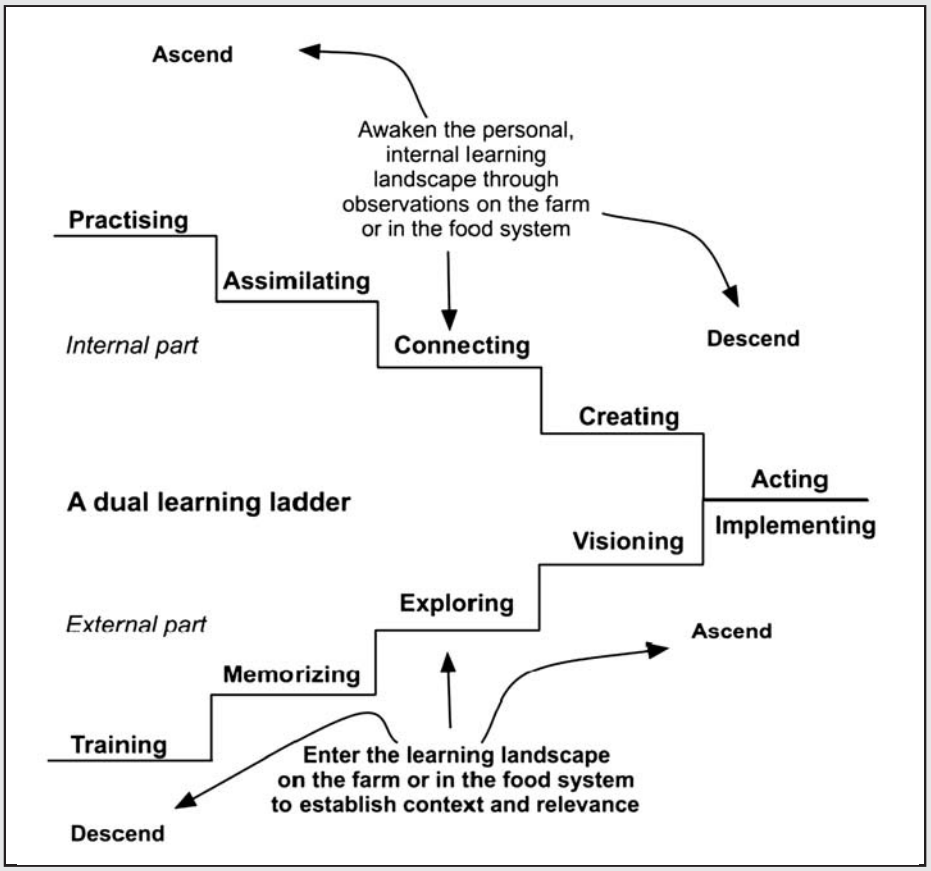

Figure 4. Combined external and internal learning ladders with cognitive steps in lower half of figure and personal growth steps in upper half of figure; linkages between steps in the two ladders are apparent, such as training in practical activities and need for practicing, memorizing new information and assimilating as an individual.

untold hours doing soil analyses in the laboratory, but knowing how the tests are conducted allows a professional to better interpret the results and know when errors have occurred. A student is learning and developing as a practical and skilled person.

The exercises to learn about myself as a practical person are essential. When students start studying agroecology at the MSc level, it is assumed that many of these skills have already been acquired in previous classes in soil and crop management, integrated pest control, economics, and agricultural engineering. Also, the wide range of backgrounds of the agroecology students has been valuable to enriching the learning community. The students can benefit from a diverse range of complementary competencies within the class through mutual learning.

Specific skills or research tools can be learned in practice on the farm or on the job in the food system. Learning is meaningful where the skills are used in context and can help answer specific questions. In the agroecology course, we feel that it is most important to learn about the context where skills will be applied, how to sort out priority questions from all those that could be asked, and integrate the use of skills with other areas of competence to better understand complex systems. The importance of working in groups and social science interviewing skills was described by a student:

"Developing tools to deal with complexity was especially useful. I believe that working in groups is a very demanding experience that leads to a lot of personal growth. The development of rich pictures allowed me to explore how to interview people to get relevant information, a skill that will be very useful in the future." [Student from United States, 2004]

Step 2: Memorizing Facts, Principles, and Theories

The adjacent step is to acquire new or more extensive knowledge, based on facts, principles and theories, one of the key goals of conventional university education. We take classes to learn new subjects or to expand our knowledge base. This is essential to be able to speak the language used in a chosen discipline and to operate successfully in that profession. For example, in ecological systems we may receive the results of soil tests from our various fields and we need to interpret that data and make decisions on cropping sequence, timing addition of animal manures or compost, or decide on addition of cover crops between those crops harvested for cash or for feed. We could call such learning the ability to memorize new knowledge and to ask questions where the answers are already well known. It is obvious that much of the knowledge we acquire will become obsolete, as new findings and interpretations make it essential to develop an autonomous style that includes a dedication to lifelong learning. A student is perfecting their abilities to learn as an assimilating person.

Learning about myself as an assimilating person is closely connected to the step of memorizing. It is difficult to keep up with advances no matter how specialized our area of interest; therefore we can accompany our students on the quest to sort out what is important and most needed to meet our goals at a point in time. The process of screening, scanning, and learning can be highly valuable as we face a future with ever-enlarging frontiers, new fields of interest,

and volumes of information that need to be considered. Thus, knowledge of the learning process may be equally or more important than the details we learn. In agroecology, the importance of putting information learned into context must be emphasized. We need to know where things apply and where they do not, how we can build the needed knowledge base to function effectively, and especially how we can efficiently navigate the information environment in the future. Then as changes occur we are prepared to dig into the details and bring ourselves up to date with what is essential to current tasks, and to understanding complex systems. A student from Canada discussed the importance of knowledge, and also where to go in the future for more details:

"I gained a great understanding of the food system, where and how to look for more detailed information, and of creative ways to bring about change. I am especially grateful for the field work experience of interviewing various stakeholders." [Student from Canada, 2003]

Step 3: Exploring: Learning to Link Theory and Practice

We think that having appropriate skills and knowledge are not enough to cause positive change in the dependability and sustainability of agricultural production and food systems. Lieblein et al. (2005) argued that often in agriculture there are greater gaps between knowledge and action than between ignorance and knowledge. To gain the confidence to apply results in the real world and to observe and understand their consequences in each unique microclimate, soil, and cultural situation requires an ability to observe, to explore, and to experiment. To apply this middle step to a given field and farm context, one could say that the students are learning to ask and answer questions where some answers are known but others are not yet known for that place. Experience may tell us that a certain fertilizer application or density of cover crop is likely to result in an expected change in cereal yield and this experience and confidence underlies the use of soil fertility principles with theories of plant growth to decide on recommendations based on field experiments. A student learns how to assimilate and evaluate multiple sources of information as a connecting person.

We use the approach of phenomenology as described by Husserl (1970) and applied by Østergaard (2003), to begin where students are immersed in the field and the food system. In agroecology we learn that the specific needs in each unique ecological farming or food system niche are not really known for the context of each farmer's field or each community, and there is a vital need to consider environmental and social impacts in addition to yields and short-term economic returns. It is lack of confidence in applications of knowledge and skills that causes some graduates in agronomy to be unwilling to accept a responsible position in extension where they may be challenged by farmers and feel unprepared to deal with high levels of uncertainty and change in the field. In experiential education in agroecology we start with shared experiences in the field, talking with farmers and coming up with shared ownership of experiments and interpretation of results. This provides students with the confidence needed for practical positions in advising and research. A Danish student found ways to use the methods in thesis work and now applies the skills and knowledge in a PhD program:

"This type of learning enabled me to grow as a person, made me aware of my own competencies, and gave me the courage to start using these in my thesis work and now also in my professional life." [Student from Denmark, 2001]

Step 4: Visioning: Learning the Capacity to Imagine Future Wanted Situations

Even with skills, knowledge, and an ability to actively explore complex topics in the farming and food system domain, we are only prepared to deal with the known questions that face the farmer and food system client today. In a rapidly changing and unpredictable field such as farming that is embedded in an international context of information flow, trade agreements, and complex support payments it is difficult to anticipate the most likely questions that will face the manager and decision maker tomorrow. In agroecology classes we often work with farmers and others in the food system to carefully describe the current situation, with constraints and opportunities, and step up to build possible future scenarios and evaluate them in relation to the farmer's or community's long-term goals. The student may explore areas where the questions are not yet known, and gain insight as a creative person to design and evaluate alternative future opportunities and directions.

Learning about myself as a creative person is vital for developing the capacity to imagine future wanted situations. To follow through with the soils examples, students anticipate certain long-term soil fertility status and soil quality as a result of using a particular rotation or application of compost or manure. In a food system, for example, students anticipate a growing interest and commitment by society to more production of organic food or to a future of scarce fossil fuels where people may depend primarily on local food sources. One could say that we as a learning community are visioning and learning to seek out areas where even the questions are not yet known. A priority on futuring is difficult for a farmer who is close to the situation, concerned about the immediate economic consequences of a cropping decision, the environmental implications of a new regulation, or the rainfall in Germany where organic wheat is also grown and competes on the world market. A priority on futuring in communities is difficult when there are streets and sewer lines to be

repaired, demands for a new sports center, and concerns about attracting new industry to build the local economy. In agroecology the priority is on learning to vision, and estimating as well as possible the consequences of alternative future pathways.

"I found the visioning activities to be the most valuable part of the courses. For example in the group work with the community, we were struggling with the task of designing future scenarios until we did the visioning exercise. Then it was clear how we should proceed and how we could take this activity to the community for them to design their own visions." [Student from France, 2005]

Step 5: Implementing: The Foundation for Purposeful Direction

Most of us have been taught or learned by apprenticeship and experience with our role models that science is assumed to be value free. Most scientists implicitly consider experiments, data collection, and conclusions derived will lead to objective action, yet there is little question that ethics and values come into the design of research and the application of results. In teaching, values influence the instructor's choice of topics in a course and decisions on reference materials, as well as the ways that we choose to present them. Our beliefs and attitudes toward the subject matter, and how to convert knowledge into action, are critical elements in the overall educational scheme and we include this dimension in agroecology education (Lieblein et al., 2005). Stated most simply, the question of attitudes could be called, "So what?" Translating learning and visioning into directed action is developing the student as a responsible person.

A student can be excellent in the classroom in memorizing facts, or in mastering a certain skill in the laboratory such as conducting a soil test. Without the dimension of values, knowing that this skill is important to apply in the field to help a farmer improve their production and their well-being, the process of education is not complete. In addition to learning skills, memorizing facts, exploring interactions, and visioning alternatives, we add implementing directed action based on values as an essential dimension to expand the education process. This does not mean that instructors force their attitudes or values on students, or insist on any specific direction, but rather provide the incentives and safe space for people to clarify their own attitudes through role play, case studies, open-ended situations, and in-depth discussions in the learning community. In the agroecology learning community, we consider the issue of attitudes to be an underlying foundation for action learning and application of science to promote more sustainable farming and food systems, and through these to better the human condition.

"I learned a lot about vision thinking, systemic thinking, and how to work in groups. But best of all it changed my life and focus for the rest of my education. It gave me the courage to follow my dreams and interests, which has put me a in a great situation now. I also learned how essential learning is and how the ideas about learning can be used in many aspects of life, professionally as well as privately." [Student from Denmark, 2002]

Conclusions

We have presented a dual learning ladder as model of the versatile learning activities and processes taking place in the Nordic Agroecology MSc program. The model consists of an external, cognitive ladder as borrowed from Bloom (1956), which describes ascending steps encompassing training of routine skills, memorizing facts and theories, exploring real-life situations, visioning scenarios of improvement, and implementing change. However, our model represents a radical break with Bloom's idea of a one-way upward movement in the learning ladder from simpler to more advanced activities and cognitive processes. In agreement with the phenomenology (Husserl, 1970) and experiential learning (Kolb, 1984) approaches, our students start on step three with exploring real-life phenomena and move freely up and down the ladder. The students step down to learn routine skills, facts and theories; they explore links between theory and practice; and they step up to envision improvements and to implement them. Several steps in this ladder inevitably involve personal emotions, attitudes and ethics. Therefore we expanded the model with a ladder that the students, concomitantly to stepping up the external, cognitive ladder, are stepping down to deepen their reflection about themselves as practicing, assimilating, connecting, creating, and acting persons, respectively. The dual learning ladder enables the students to understand and act within agriculture and the wider food system and to practice reflection as basis for personal growth.

"The semester completely changed my views on education, moving from a quest for knowledge and answers to an exploration of questions, and of ways to bring about meaningful change as a community." [Student from Canada, 2003]

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