D3.1: Educational Approaches

WP3 – Future curriculum, education and training

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Preface

In our Nextfood project application we described WP3 – Future curriculum, education and training system and this deliverable as follows:

The agrifood and forestry curricula to be studied and further developed will focus on sustainability challenges at various scales: local; regional and global. Curricula will also focus on empowering actors to mitigate these challenges and, thus, encourage agrifood system change to reach goals of sustainability and food equity. In WP3 we will synthesise and analytically generalise data from the inventory of skills in WP 1 and from the case studies as managed by the principal contributors in WP2, and feed the newly gained understanding back to those designing cases to support further case development. The curriculum development at this aggregated level will follow the steps of the NEXTFOOD's action research strategy throughout the course of the project:

1) Synthesize existing curricula in the field, including those analysed in WP1. This includes data on educational approaches, learning goals, and program assessment procedures. Further input will be obtained from the case studies managed in WP2.
2) Envision, design and develop future curricula, including course structure, content and methods, assumed to foster learning to enable transition to more sustainable agrifood systems.
3) Identify key issues and forces supporting or hindering replacement of current curricula with new ones effectively supporting transition to more sustainable agrifood systems.
4) Make action plans for implementation of new curricula.
5) Implement newly developed curricula in the cases.
6) Evaluate the impact of the new curricula on students' understanding and competence. This occurs throughout the course, and includes assessment of student performance, as well as gathering feedback from students and teachers.

Task 3.1.
Create an overall framework to assess and improve the current educational approaches of involved cases. In this task, we will define overall educational goals, curriculum models, strategies and methods to be adapted and further developed in each case, and develop a process that will support each case to reach learning goals. This task corresponds to step 1-2 in the curriculum development process described above. The output from WP1 will be used for identifying effective approaches and methods for fostering essential skills needed in agrifood and forestry systems and related value chains, covering primary producers, advisors, industry, businesses and scientists. An overview of the most suitable approaches and methods will be synthesized into a new NEXTFOOD educational strategy for incorporation in existing curricula of the cases. We will identify a number of educational goals and form an initial working hypothesis about meeting them. Next, we will plan a curriculum model and devise materials and processes to support it, including process workbooks and learning diaries for individual work, process workshops to support positive group functioning, and coaching support.

During the Nextfood consortium meeting in May 2019 we organised a workshop where the consortium participants were organized into small groups, and asked to answer the following question:

What three of these aspects would you like to read more about in the report on educational approaches (D3.1)?

1. A deep understanding of what it means to learn from experience
2. Understanding of different kinds of knowledge (theoretical knowledge, practical wisdom, technical knowledge (Aristotle))
3. A shift from lecture hall to a variety of learning arenas
4. A shift from lecture to co- and peer learning
5. A shift from textbook to a diversity of teaching aids/multiple sources of knowledge
6. A shift from written exam to a diversity of ways of assessment
7. A shift from being a lecturer to becoming a learning facilitator
8. The five core competences
9. Systems thinking
10. Others?

Their answers were used to select and organize the topics in this report.

Executive summary

Intertwined environmental, economic, political, and social challenges require transdisciplinarity, systems thinking and facilitation of informed action in an era of uncertainty and rapid change. Yet, our formal education is still largely based on the transmission of neatly packed disciplinary bodies of knowledge, presented as unambiguous truths. How we learn to see the world strongly influences what we do in the world. Consequently, there is an urgent need to re-think education and shift the overall focus in education from theoretical knowledge alone to the competences that are needed to support sustainable development. To meet such a demand, the work package two of the Nextfood project has explored relevant educational approaches, and built them into an overall Nextfood approach to education in agrifood and forestry systems. Such an overview can serve as a source of inspiration to HEI's that are interested in educational transformation.

The first chapter provides an overview of the challenges that we face regarding sustainable development of agrifood and forestry systems, and the necessary educational response. Chapter two presents what it means to learn from experience, emphasising the importance of action for learning. In chapter three the overall focus of the educational approach of Nextfood is described in more detail, emphasising the new roles of teachers, students and stakeholders in the learning landscape. The core sustainability competences included in the Nextfood approach is described more in depth in chapter four, and chapter five provides a condensed overview of systems thinking for practice. In chapter six, institutional prerequisites for the necessary educational transformation is presented. Chapter seven contains an overview of the changes that are necessary for a shift towards the Nextfood approach, and chapter eight provides an outline of what the Nextfood approach in education will require from teachers, students and institutions.

1 Sustainability challenges and the need for an educational response

1.1 Unsustainability challenges

Since the scientific and industrial revolutions, human activities—including those within the agri-food and forestry sectors—have been able to provide for the needs and wishes of a large portion of people, especially in the global North. The rapid population increase through the 20th Century was unprecedented in the history of humankind. As a result of education, medicine, and economic pressures, this growth rate has slowed substantially in the last two decades. An overwhelming body of evidence shows that achievements in food production have been made largely by consumption of finite production resources, at the expense of ecosystems and environmental conditions upon which human existence depends, and the cost has fallen disproportionately on less favoured human individuals and populations (IFAD, 2013; IPBES, 2019; IPCC, 2019; IAASTD, 2009). In economic terms, revenue in current systems in large part depends on externalisation of costs (Gliessman, 2015; Ikerd, 1993). Furthermore, despite the impressive production success of the industrialised, globalised agrifood system, such advances have been unable to prevent hunger and malnourishment for much of the developing South, and internal inequities in access and affordability have created pockets of undernutrion in most countries. Currently, we have the paradoxical situation that global hunger is on the rise after a prolonged decline (https://www.un.org/sustainabledevelopment/progress-report/), while the number of obese people has surpassed the number of under-nourished people (IPCC, 2019).

Land use changes, including their upstream and downstream decisions and consequences, play an important part in contributing to global social, economic, cultural and ecological changes taking place on levels rarely seen before, threatening several 'planetary boundaries' in the long term and resulting in ecological unsustainability (IFAD, 2013; IPBES, 2019; IPCC, 2019; IAASTD, 2009; Rockström et al., 2009):

> *"The natural environment is deteriorating at an alarming rate: sea levels are rising; ocean acidification is accelerating; the last four years have been the warmest on record; one million plant and animal species are at risk of extinction, and land degradation continues unchecked." United Nations Secretary-General António Guterres. (https://www.un.org/sustainabledevelopment/progress-report/)*

1.2 Sustainability challenges

The current impacts of human activity on a global scale and resulting unsustainability call for substantial and transformative changes (Barth, 2016; IPBES, 2019; McAlpine et al., 2015). For agri-food and forestry systems this implies a better alignment of human needs and wants with fundamental principles for ecological, economic and social sustainability (Björheden, 2019; De Schutter, 2010; FTP, 2019; Gliessman, 2015; Hansen and Malmaeus, 2016; Hatt et al., 2016; IFAD, 2013; Ikerd, 1993; IPBES, 2019; IAASTD, 2009; Kremen et al., 2012; Rainforest Alliance, 2016; SFI, 2019; Wals and Corcoran, 2012; Wolfslehner et al.).

Because of the extreme complexity of the current situation and the unpredictability of the future, sustainability is a multi-faceted, ill-defined concept and a moving target (Bell and Morse, 2005, 2008; Gliessman, 2015; IPCC, 2019). There is growing evidence that a relatively radical transition will be necessary (De Schutter, 2010; Gliessman, 2015; IFAD, 2013; Ikerd, 1993; IPBES, 2019; IAASTD, 2009; Wals and Corcoran, 2012), related to an Ecological Economy (McKibben, 2007 on 'Deep Economy' in (Wals and Corcoran, 2012), or a 'Deep Ecology' (Drengson and Inoue, 1995). There is still controversy about how radical the changes need to be, ranging from optimisation or revision of current systems ('doing things better') to complete system re-design ('doing better things') (Gliessman, 2015; McAlpine et al., 2015; Wals and Corcoran, 2012). The complexity of interacting political, cultural, biological and economic issues in natural resource management—which is further complicated by different worldviews of actors involved and uncertainty—makes transition towards a desirable future vision of sustainability a huge challenge (Gliessman, 2015). Such dynamically complex challenges, where there is usually not consensus about what the problem is and a substantial uncertainty, are frequently termed 'wicked problems' (Batie, 2008; Hjortso et al., 2005). Reduction of greenhouse gas emissions and global climate change are among several prominent contemporary examples.

What seems clear is that a transition towards sustainability will rely on systems thinking, on constant negotiation and societal learning processes involving all relevant stakeholders to address policies, institutions and governance systems at all scales, and on coordinated action across a range of actors (Barth, 2016; Bell and Morse, 2005, 2008; Gliessman, 2015; Ikerd, 1993; IPCC, 2019). It is essential to promote communication among often competing interests in order to meet what are seen as incommensurate goals and expectations. "Embarking on the path of sustainability will require a profound transformation of how we think and act" (UNESCO, 2017). This means that we need new knowledge, skills, values and attitudes (UNESCO, 2017), which may be termed 'sustainability competences' (Frisk & Larson, 2011). Education, therefore, is key for the pursuit of sustainability (UNESCO, 2017), and "it is not just a matter of knowing *more* but also of learning and knowing *differently*", as "systemic development of complex, purposefully-managed natural resource systems is essentially a function of the development of the consciously reflexive and critical learning systems embedded within them." (Bawden, 2005).

1.3 Required educational response

Intertwined environmental, economic, political, and social challenges require transdisciplinarity, systems thinking and facilitation of informed action in an era of uncertainty and rapid change. Yet, our formal education is still largely based on the transmission of neatly packed disciplinary bodies of knowledge, presented as unambiguous truths (Batie, 2008; Ison, 1990; Orr, 2004). How we see the world strongly influences what we learn and what we do (Bawden, 1991). Consequently, there is an urgent need to re-think education of various stakeholders, including future leaders and decision makers (Ferdig, 2007), to increase consciousness about living in ways that account for ecological and social impacts. Such education should rest on complexity science and see a reality that is interconnected, unpredictable, and self-organizing (Marion, 2008). Further, focus should be on 'sustainability competence' (Carlisle et al., 2019; Kelsey and Armstrong, 2012; Nelson and Cassell, 2012; Orr, 2004; Pretty, 1995; UNESCO, 2017; Wals and Corcoran, 2012; Wiek et al., 2011). "This necessitates a shift in mind-set that goes beyond 'doing things better' or 'doing

things differently' towards a paradigm change of learning to alter the way we look at things completely" (Barth, 2016). This shift includes critical reflection on both means and ends of education (Wals and Corcoran, 2012). Generic knowledge about sustainable development is essential but not sufficient, as knowledge alone does not necessarily lead to action (Pfeffer and Sutton, 2000). The sustainability challenges call on an action-oriented, transformative pedagogy, which supports self-directed learning, participation and collaboration, problem-orientation, inter- and transdisciplinarity and linking of formal and informal learning" (UNESCO, 2017). The sustainability challenges require people who can understand the world from a systems perspective and perform leadership that rests on collaboration, inclusion and empowerment (Burns et al., 2015).

Thus, the challenge is to design and implement an effective learning strategy that overcomes the knowing–doing disparity by enhancing both the learners' understanding of complex situations and their individual and collective skills and abilities to take informed, responsible action (Burns et al., 2015; Kelsey and Armstrong, 2012; UNESCO, 2017; Wiek et al., 2015). As competences cannot be taught, but have to be developed by the learners themselves during action and reflection on the experiences (UNESCO, 2015; Weinert, 2001), the understanding and competences needed to deal with sustainability challenges are best conveyed when learning is action-oriented in real-world settings (Wiek and Kay, 2015). Education for sustainable development thus requires putting phenomenology into practice and "a shift from teaching to learning" (Francis et al., 2013). Such action learning has successfully been used for leadership development training in the business sector (Smith, 2001), and in agroecology (Francis et al., 2016; Francis et al., 2017).

Important ends of education for sustainability include the competences of creativity and visionary thinking (Kelsey and Armstrong, 2012; OpenIDEO, 2019; Wals and Corcoran, 2012), observation and reflection (Baker et al., 2012), participation (Pretty, 1995) and dialogue (Isaacs, 1999) and ability of systems thinking (Carlisle et al., 2019; Molderez and Ceulemans, 2018; Nelson and Cassell, 2012).

2 Learning from experience

2.1 Phronesis helps create a path to the future

In contrast to his teacher Plato, to whom the sensual world was merely a shadow of the real world, the world of ideas, Aristotle (384–322 BC) placed observation of the empirical world at the core of knowledge. This difference is illustrated in Rafael´s painting 'The school of Athens' (see Fig. 1), where Plato is pointing his finger up towards the world of ideas, while Aristoteles stretches his hand out towards the empirical world.

Figure 1. Detail from School of Athens, fresco by Raphael (1508–11). (Album/Oronoz/SuperStock)

An important contribution from Aristoteles is that he identified different forms of knowledge. In addition to *phronesis*, there are two other forms of knowledge, *episteme* and *techne*.

"*Episteme* is characterized as scientific, universal, invariable, context-independent knowledge. *Techne* is characterized as context-dependent, pragmatic, variable, craft-oriented toward practical instrumental rationality governed by a conscious goal. The original concept appears today in terms such as *technique, technical* and *technology" (*Kinsella and Pitman 2012).

Differing from, but linked to, pure theoretical, de-contextualised knowledge (*episteme*), *phronesis* is a form of practical knowledge that is normative and directed towards action. This form of knowledge cannot be acquired by reading alone, but rather is developed through experience in exercising a competence, such as reflection and dialogue, and in being exposed to everyday contexts. According to Kemmis (2012), "…phronesis is not something that can be taught; it can only be *learned,* and then only by experience" . *Phronesis* "involves deliberation that is based on values, concerned with practical judgment and informed by reflection. It is pragmatic, variable, context-dependent, and oriented toward action" (Kinsella and Pitman, 2012, p. 2). Birmingham

(2004) describes phronesis as a competence that is directed towards the specifics in a situation. In an agrifood and forestry context, phronesis can be informed by generic knowledge (episteme), but phronesis is never merely an application of relevant theory, partly because of the complexity and ambiguity of specific situations in the field.

Such a focus in learning has received increased attention in recent years in educational programs, such as teacher and medical education (Kinsella and Pitman, 2012). We propose that a greater emphasis on *phronesis* in agrifood and forestry education can be fruitful for students to cross the gap between knowledge and action, and to enable responsible actionin the wider sustainability context. What characterises *phronesis* is all about reasoning about what to do (Eikeland, 2014).

> *"Although practicing this virtue means that one distinguishes what should be done from what should not, it is not simply practical shrewdness and practical cleverness. The distinction between what should and what should not be done includes the distinction between the proper and the improper and thus presupposes a moral attitude, which it continues to develop" (Gadamer, 1975, p. 22).*

Connecting the generic to the specific within an ethical atmosphere is the base for phronetic ways of thinking (Hovdenak, 2016). Nussbaum (1997) argues that episteme and techne are insufficient as knowledge forms in education. She argues that in profession-oriented education that involve interactions between people, phronesis is of fundamental importance. Professional assessments involve complex interactions between the generic and the specific (Nussbaum (1997) in Hovdenakk (2016)).

2.2 An experiential and action-oriented approach

John Dewey developed many of the basic ideas for experiential learning. He further emphasised that the ethos of learning is that it happens through and for action (Dewey, 1916). His emphasis on doing *and* reflection as the source of learning focuses on our experiences and actions in the world as the point of departure for the learning process. It is however important to be aware of Dewey's warning that we do not learn by *doing* alone, the doing must be followed up by reflection on our experiences, what can be called *reflective practice*. The task of the teacher will then be to create the environment where the students' doing and experiencing can take place and then facilitate the reflective activity as a follow-up (van Manen, 1990). Such an approach also necessitates a specific focus on cultivating the students' reflective competences, and to link the students' reflective activity to their own experiences. A core guiding principle of Dewey´s pedagogical thinking is that education should not be done by an authoritarian approach, but rather start with the experience of each student (Dewey, 1916).

Based on Dewey´s initial ideas several other pedagogical methods have been developed, such as experiential learning (Bawden et al., 2000; Kolb, 1984) and problem based learning (Barrows, 1986). According to Baker et al. (2012), "Agricultural education has been experiential in nature since its inception". Although agricultural students have had many opportunities to experience field situations, there is a challenge for teachers to move beyond the 'doing', and ensure that the experiences are used as base for conceptualisations (Knobloch, 2003). What is mostly missing is the linking of experiences to reflection and further action. Birmingham (2004) argues that reflection is not a neutral but a moral activity:

> *"Even Dewey (1933) who wrote perhaps the most commonly cited definition of reflective thinking – "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends" (p. 9) – maintains that being reflective involves more than thinking reflectively. Although reflection is driven by reflective thought on what is good and how to achieve it, reflection includes attitudes and actions as well for "there can be no such thing as reflective morality where there is not solicitude for the ends to which action is directed (Dewey 1932, p. 30)."*

Kolb (1984) was inspired by Dewey, but also by other scholars like Kurt Lewin and Paolo Freire when he developed an Experiential Learning Theory (ELT) that states "Learning is the process whereby knowledge is created though the transformation of experience" (p. 38) (Baker et al., 2012). All these scholars placed purposeful action based on experience at the centre of learning (Kolb and Kolb, 2009). As such, experience in itself does not lead to learning. For that to happen, the learner must reflect, and use the newly created knowledge towards purposeful action. Kolb (1984) viewed learning as a cyclical process that starts with an initial experience and ends with actions to improve the situation where the initial experience took place. He further emphasised the flux between observation and conceptualisation and between reflection and action in the cyclical process of learning.

Boud and colleagues (1993) built on Dewey when they emphasised that 1) experience is the foundation for learning, 2) learners actively construct their experiences, 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.

Our ability as learners to reshape our assumptions about the world through reflection on our experiences is the focus of *transformative learning* as developed by Mezirow (2000). Mezirow (2003) defines transformative learning as " …learning that transforms problematic frames of reference–sets of fixed assumptions and expectations (habits of mind, meaning perspectives, mindsets)–to make them more inclusive, discriminating, open, reflective, emotionally able to change. Such frames of reference are better than others because they are more likely to generate beliefs and opinions that will prove more true or justified to guide action". As such, more appropriate action is the goal of the transformative learning process in the flux between reflection and action.

2.3 Connecting phenomenology and learning

Phenomenology can provide an additional point of departure for designing and running educational activities based on the Nextfood approach. A prerequisite for the philosophy of phenomenology to become valuable in this context is that it can be translated into concrete pedagogical activities. Such a translation is possible when the primary status and value of phenomena as they are directly experienced, is recognised in the learning (educational) process.

Phenomenology emphasises the importance of returning "to concrete, lived human experience in all its richness" (Moran, 2000, p. 5). Husserl´s (1970) statement "to go back to the things themselves", as they are, has been central in phenomenology for more than a century (Francis et al., 2016). Such an activity can be called 'preconceptual', because concepts are initially not sought after, but rather a rich, experience of the phenomenon, and then have these experiences form the basis for conceptualisation and learning. As such,

> *"Phenomenology forms a critique of the theory-first dogma", which rules academia in the conventional classroom, the knowledge and theories behind what the student experiences have become more scientifically correct than the experience itself. This situation easily creates a gap between the world of scientific knowledge-based explanation and students´ experienced lifeworld. In contrast to theory centric learning and teaching of traditional academia, our approach to agroecology is grounded in phenomenon- and experience-centric learning" (Francis et al., 2016).*

The 'theory first dogma' is rooted in the first scientific revolution, starting 400 years ago. In its initial phase, Galileo and other scientists emphasised the need to use our own senses to experience the world and to make those experiences the basis for knowledge development. In the evolution of natural sciences as a discipline, the early emphasis on observations was transformed into an approach where mathematical representations and scientific concepts took over the role as the starting point of the learning process. Rather than the immediate sense-based experiences, the quantitative and model-based representations of the world were held to be the truth. According to Husserl (1940), the German founder of philosophical phenomenology, a result of this scientific revolution was that science lost its contact with the lifeworld. Harvey (1989) calls this an ontological reversal, because our immediate experiences of the world are replaced by abstract models from science in terms of what is real, from an ontological point of view. As a result, teachers will be less concerned about the students' immediate perception and experiences, and more concerned about providing them with the necessary cognitive content of a subject matter. Francis et al. (2016) state that "the phenomenological critique of this ontological turn is explicitly expressed by Husserl and Heidegger and by science educators like Wagenschein (1990). This critique also forms the basis for an *ontological re-reversal,* where lifeworld phenomena are given back their ontological primacy". And further:

> *"A pedagogical implication of the ontological reversal is that that teaching is planned "from the end" (Wagenschein, 1990)….In conventional teaching approaches, phenomena are given a secondary significance, whereas theory of the phenomena, relevant concepts, theories, and models to explain phenomena are all of primary importance. A phenomenon-based teaching starts ideally from open-minded sense experiences, in students´ everyday, personal and intuitive knowledge. From this foundation, the teacher designs a learning path towards theories, models and abstract knowledge. This ensures that scientific concepts are rooted in experience, and not merely jumped into for convenience. Agroecology education "planned from the start" involves a primary focus on perceptual lifeworld experience and a secondary focus on cognitive activities in which these experiences are reflected and explained" (Francis et al., 2016).*

This means that students must observe and participate in agrifood and forestry- related practices, and use experiences from participation and observation to generate knowledge about these systems. The action dimension of the Nextfood approach finds a conceptual foundation in the works of the phenomenologist Maurice Merleau-Ponty (1992), who proposed that acting in the world comes before reflecting about the world. A consequence for education is that an action orientation should not be an add-on issue, but rather be viewed at the core of the educational activities. The action learning dimension of the Nextfood approach is important because it emphasises the close connection between learning and human development. A basic principle in action learning is that action and learning can be viewed as one and the same thing (McGill and Beaty, 2001). Phenomenology as we have described it here, is well aligned with the works of John Dewey on learning and experience.

2.4 A dual learning ladder

The learning process can also be viewed as a dual learning ladder, to enable insight into the external and internal dimensions of learning and action. Francis et al. (2007) state that:

> *"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."*

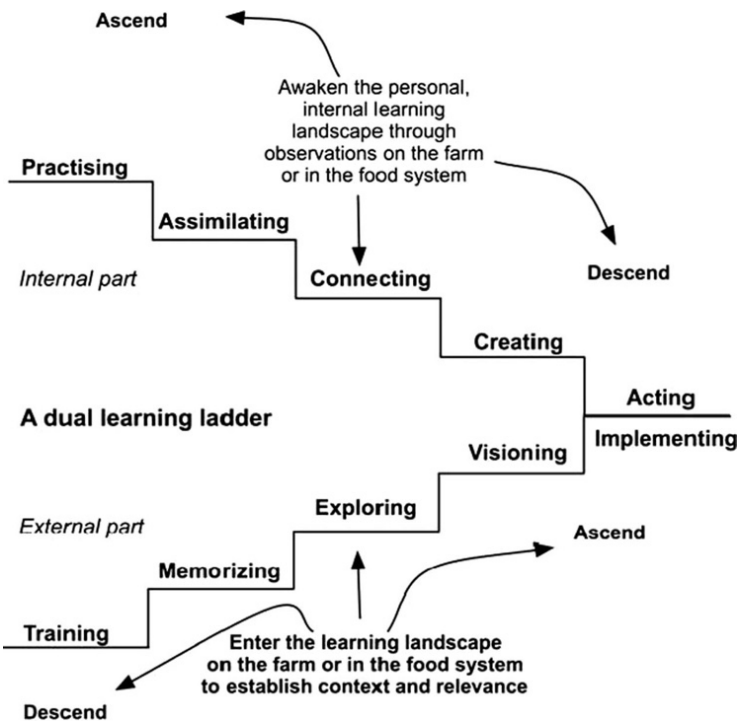

Figure 2. Student learning in the inner and outer world (from Lieblein et al. (2007))

2.5 Learning towards the future

One key lesson from the phenomenological approach is recognising a need for renewed emphasis on our immediate sense experiences as basis for learning. Agrifood and forestry-related education should start with experiences on farms, in forests and in communities, and then build the learning process based on those shared experiences. This means that students must observe and participate in farming, forestry and food related practices, and use experiences from participation and observation to generate knowledge about farming and food systems through reflective activities. According to Pfeffer and Sutton (2000), knowledge gained from experiences will more likely lead to action than knowledge based on listening to lectures and reading books. As such, experiential learning is an important approach to learning about agrifood and forestry issues, but there are some short-comings. Processes and patterns of the past do not necessarily contain what is needed to deal with the challenges of the present and the future. It is therefore not sufficient to learn from the past, we also need to develop a fundamentally different kind of learning, a learning towards the future (*bringing the inside out).* It is vital that students are not continually hung up with what happened yesterday or during the last weeks; they also need to focus on tomorrow. In the quest for sustainable development, there is a need for cultivating the ability to learn towards the future as a second phase of the scientific revolution (Scharmer and Kaufer, 2013).

Building learning on experiences is based on imagination (*phantasia,* from Hellenistic philosophy*)*, an ability that is the basis for all cultural activities. One component of imagination is the ability to recall and remember, which is about the ability to bring forth an image of the thing that happened, give it a name, a meaning, a concept. This ability can be called *empirical imagination*, of which science is a product. The empirical imagination relates to what is already there, and produces a worldview. Up against this ability is the human ability to create images of a reality that do not exist in the present, but is one that is desired (the will to create). This ability can be called moral imagination, and is the source for visionary thinking (see chapter 4).

If experiential learning is about the careful observation of the outside world through our senses, and cultivating those senses, then the new learning cycle needs revised focus and a new source of learning. Kolb's learning cycle has the environment as the source of learning (learning from without), whereas the new learning cycle has our inner reality and creativity as crucial sources of learning (learning from within). Imagination is the ability to transcend existing patterns, those prevailing patterns of yesterday, and as a result cultivate the ability to see completely new solutions.

We propose that in the development from a known past to an unknown future, where the sustainability of the human race is at stake, the competence that we have called moral imagination, or visionary thinking, will be of vital importance.

3 The Nextfood approach

3.1 What is the Nextfood approach all about?

Figure 3 illustrates the core elements of the approach that has been chosen in the Nextfood project: To facilitate the transition from conventional, lecture-based education focused on knowledge accumulation to phenomenon-based and action oriented learning aimed at the transformation needed to cultivate the competences required for sustainable development.

Often academic institutions and the larger society are viewed as different entities where the new knowledge is created at universities, to be applied by others in different sectors of society. Our goal in the project is to create a shared dialogue space between all the players, where students, teachers and resource persons from society (for simplicity we call these extra-university stakeholders, or stakeholders) can meet and learn from each other, while they together aim to tackle sustainability challenges. A set of five core competences have been identified as crucial to enable collaboration, learning and development in the dialogue space: Observation, Reflection, Participation, Visionary Thinking and Dialogue.

In alignment with such an approach to education, the Nextfood project applies the same process in its research and development activities, using a case-based and action-oriented approach to development and generation of generic knowledge that can be used by others. Based on Kurt Lewin's (1942) Field Theory, the hindering and supporting forces for the intended change will be explored, providing a foundation in each project site and basis for action plans for how to overcome the hindrances and build on the supporting forces.

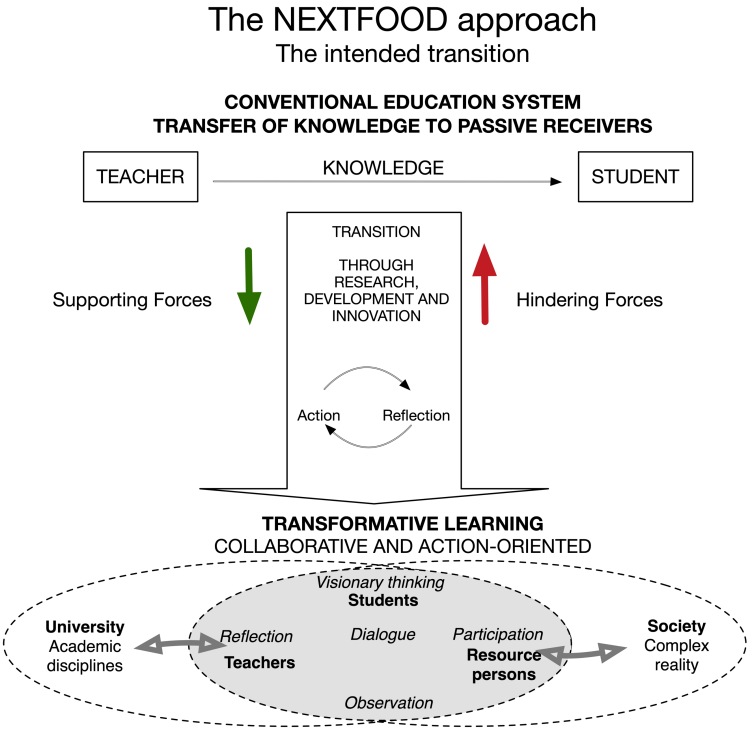

Figure 3. The Nextfood approach: The transition towards transformative and action-oriented Learning (Adapted from Lieblein et al. (2012)

3.2 Students bridging teachers and stakeholders

The phenomenon-based and action-oriented approach that characterises the Nextfood approach requires situations out in the field that are not simply viewed as examples of the concepts and models previously presented in the classroom, but in contrast they are treated as the point of departure for the learning process. To implement this concept, the phenomena are given primacy over theories in the educational process. This reversal has the aim of bridging the university environment where most education traditionally takes place and the stakeholder environment of farming, forestry, and food systems. The teachers help the students gain access to the stakeholder environment by bringing in a key stakeholder from the agrifood or forestry sector, and introduce the students to relevant theories and concepts, and practice the necessary core competences in the classroom. The students then become 'citizens of two worlds', and the task for the teachers is to help the students integrate what they experience in these two worlds. From the stakeholders they receive knowledge from practice and from the teachers they receive knowledge from theory, and the students should learn to give appropriate weight to these two kinds of knowledge, and practice how to ensure that each will feed into the other. The distance between case-based systemic knowledge and discipline-specific knowledge represents another bridging challenge for the students. Wals et al. (2004) propose that students and teachers must become reciprocal members of a learning community to enable an integrative educational process to emerge. In the Nextfood approach the stakeholders should also be part of such a community.

3.3 Role of core and single discipline teachers in the dialogue space

To fully practice action learning, the students must learn to appreciate how they can co-create knowledge with the stakeholders through dialogue. The second prerequisite for action leaning to be become successful is that the students develop an ability to link specific discipline knowledge or any other knowledge to concrete situations in the field. The task of the core teachers is to help the discipline-specific teachers link their knowledge to the different phenomena of farming and food systems, and to facilitate good interaction with stakeholders involved in the students´ action learning. When students return from case work, they will bring questions both at the whole system level as well as at the single discipline level. These questions can provide a point of entrance for the single discipline teachers. As such, the concrete cases the students bring into the classroom can form the base for interdisciplinary discussions and activities. In this flux between the stakeholders, and the core and single discipline teachers, the students can experience what Bleakley and Bligh (2008) refer to as an *inter*-professional experience.

Østergaard et al. (2010) state that:

> *"The glue to inter-professionalism is not a common theory, but rather a common task. In the phenomenological approach, the learning process is derived from the students' experience and their individual and group-based learning. Teachers work together with students on issues that emerge during discussions of sustainable development of farming and food systems".*

3.4 Stakeholders' role in the dialogue space

Even though farmers and other practitioners are present in conventional agricultural education, they are not given a specific and legitimised role in shaping the curriculum. They mostly are brought in as farm owners or managers during farm visits, whereas the 'real learning' takes place in the classroom. Østergaard et al. (2010) propose that "In a stakeholder-centered form of education, on the other hand, the core relationship is the one between the students and the stakeholders, with teachers as facilitators, and the emphasis is on providing a dialogue between the two groups to create knowledge". As co-creators of knowledge, the stakeholders take on a new role, from a relative passive role in conventional education to that of being a teacher in this new approach. In their roles as teachers, stakeholders can contribute with their lived experience, not encapsuled by disciplinary boundaries, to also encourage the students to transcend the academic sphere in their development as professionals (Bleakley and Bligh, 2008). Reflection sessions in the classroom are well suited for going deeper into what the students have learned from the stakeholders.

3.5 Students' role in the dialogue space

The students' learning is both an individual and a social process, at the centre of the educational activities. Action learning in farming and food systems involves highly complex and dynamic situations in the field, necessitating contributions from several persons. The role of the students will thus be to work efficiently in teams with often a high degree of diversity, and they should practice group skills within the 'safe space' of being students. Student engagement and participation will be crucial for success in the dialogue space. According to Ison (2007) participation in education only makes sense when the overall activity has a purpose of improvement in the field. The learning goals for the students is not to find answers that the teachers already have, but rather to learn about complex and messy situations in the field (Francis et al., 2001), and even go beyond what teachers have to offer. As part of such a learning process, their task is to 'bring the case' into the classroom, where they can try to tackle case-inherent challenges, facilitated by their teachers.

4 What are the core competences?

4.1 The core Nextfood competences

The next generation of professionals in the agrifood and forestry system need to acquire and practice certain key competences that will be essential through their academic and field studies, and subsequent activities in future professional positions. They must have the capacity to deal with the whole of a situation, and not just the parts. They need to be able to orient themselves beyond disciplines and sectors, to enable ethically sound decisions and action.

We consider these competences to include skills in *observation*, in *participation*, in *dialoguing* with peers and other stakeholders, and in *visioning* desired sustainable futures. Imbedded in each of these skills is an ability to *reflect* on one's own experience (Francis et al. 2016). In addition, the sixth core competence, *facilitation,* is the ability to enable others to cultivate the other five competences.

4.2 Observation

The competence *Observation* is described as follows in the description of how to do "Self assessment of core competences", published in the Nextfood D2.1: Action Research Protocol:

> *"Observation is the competence of carefully examining situations in the "world out there" with which you are confronted, before you make any judgements about the situation. This has the intention of an unbiased examination.*

According to Francis et al. (2016), the emphasis on observation is rooted in Husserl's (1970) phenomenology:

> *"…we emphasize pure, unbiased skills of observation. This predisciplinary, preconceptual, nonjudgemental approach is important to allow for a rich, aesthetic experience. Suspension of judgement is further an important prerequisite for being able to deal with the whole of a situation, and not just some predefined parts. Valuing the role of observation as an important source for learning and action, and not just one that provides an illustration of what is already known, is another prerequisite for developing this skill"*

In agrifood and forestry education the competence of observation can be introduced through exercises both in the classroom and in the field. The aim of these exercises is to sharpen the senses, as well as student awareness regarding the difference between observation and judgement. Such an awareness is crucial to be able to suspend judgement in a situation until an overview has been established. Such a suspension is necessary in complex and ambiguous situations to avoid quick-fixes that often lead to unwanted negative consequences. Learning to value observation as the starting point for learning about complex situations in the field is important, but often represents a challenge for many students. A main reason for this challenge can be seen in the light of the ontological reversal described by Harvey (1989) in education, where cognitive issues such as theories and mathematical models have taken the position considered to be the 'true reality'. Since what we observe is viewed as subjective and not representative of what is the real situation, there has been little emphasis on observation in education.

4.3 Reflection

The competence *Reflection* is described as follows in the description of how to do "Self-assessment of core competences", published in the Nextfood D2.1: Action Research Protocol:

> *"Reflection is a process of exploring and examining ourselves, our perspectives, attributes, experiences and actions and interactions. It helps us gain insight and see how to move forward. It increases our ability to link our own experiences to theory and to personal development."*

Francis et al. (2016) state that:

> *"From Heidegger's phenomenology and his explicit focus on our already being in the world and our preunderstanding as a prerequisite for understanding and reflection, we draw the skill of reflection. In agroecology, reflection is characterized by a "Janus-quality" (after the Greek and Roman god, Janus), with one face looking outward into the world of food, agriculture, and the environment, and the other face looking in the opposite direction, into the inner world of the student. The challenge for the student is to value the importance of both perspectives and to cultivate the links between the two. Our task as educators is to provide a safe and encouraging learning environment, where students can explore ideas and learn to link their prior experience with new knowledge and skills, and to combine these into a capacity for visioning a desirable future."*

According to Kolb (1984), experience is transformed into knowledge through reflection. Dewey (1938) proposed that "we do not learn from experience… we learn from reflecting on experience". In an earlier elaboration on reflection, he defined the reflective activity as an "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends" (Dewey, 1933, p.9). Because of the crucial role of reflection as a structured activity to enhance learning (The Nextfood approach), it should be introduced as a core competence during the initial days of the educational process, and be followed up with weekly reflection sessions to practice this competence. As a part of these weekly sessions, the students should also get the experience of facilitating reflection sessions. Students should be encouraged to write a daily learning log as well as a final reflection document where they sum up what they have learnt during the course, eg. how they have met the educational objectives with course activities. According to Mezirow (2000), "Reflection enables us to correct distortions in our beliefs and errors in problem solving. Critical reflection involves a critique of the presuppositions on which our beliefs have been built". As such, the reflective activity shapes the path towards what Mezirow and Associates (1990) call transformative learning: "…learning experiences that leave a significant impact on the learner, a paradigm shift that shapes the learner and affects subsequent experiences". Whereas the competence of *observation* explicitly deals with the world in which we live, *the outer world,* reflection can be called *'observation in the inner world'*. When we reflect, we relate to our experiences as well as relevant theory, in the mode of empirical reasoning, and then proceed towards the future, through moral reasoning: What are the implications of what I have learned for what I should do in the future? In such a shift towards the future in reflection lies the moral, and the emancipatory dimension of reflective activities.

4.4 Participation

The competence *Participation* is described as follows in the description of how to do "Self assessment of core competences", published in the Nextfood D2.1: Action Research Protocol:

> *"Participation is the competence of participating in work in the field, not as a distant observer, but rather with personal commitment and dedication in interaction with different stakeholders."*

Several scholars use participation as a metaphor for learning (Girard-Groeber, 2018; Lave and Wenger, 1991; Rogoff, 1993). Participation can be interpreted as a transformative process focused on making a difference, as opposed to accepting status quo. The process of guided participation provides a link between previous experience and competences needed to solve new problems (Rogoff, 1993) (Reid et al., 2008).

Too often in academia an active participation on farms, in food systems, and as a member of society has been considered an 'extra-curricular' activity. Students have pursued active involvement in environmental, political, and social causes that are highly relevant to them personally, but these have not been considered integral to their formal education. We have often encouraged students in the university to embrace broader interests, knowing that the skills and experience gained outside the confines of the classroom can lead to preparation for professional socialising and contributions to the work environment in the future.

According to Francis et al. (2016)

> *"We often tend to regard participation and action as being outside of the academic realm. From Merleau-Ponty´s phenomenology with its focus on bodily lifeworld presence and acting as foundation for conceptions, we derive the skills of 'participation' and involvement. The recognition of the value of participation and involvement for the learning process is a vital part for developing this skill".*

The MSc agroecology programmein Norway includes the competence of participation as a key part of learning, and we spend time with them practicing skills in the field by having students spend part of their first weeks in class working on farms and interviewing farmers and food system professionals (Francis et al., 2016).

One challenge for us to overcome is the concept still held by many students that in their former educational institutions such experience was not validated as useful to complement the classroom activities. Yet people quickly adapt, and most embrace the challenges of broad participation as valuable to learning. We have observed students gaining these skills, and found in their reflection documents a confirmation that their time spent in active participation has contributed substantially to their overall competence to perform as an agroecologist in the agroecology class and in future positions. In addition, their participation has provided a shared experience that provides context for classroom discussions, and contributes to their effective functioning in teams in the farming and food systems projects that are part of our autumn course in agroecology.

4.5 Dialogue

The competence *Dialogue* is described as follows in the description of how to do "Self assessment of core competences", published in the Nextfood D2.1: Action Research Protocol:

> *"Dialogue is a process which helps us notice the nature of our thinking. Dialogue increases our capacity to move into and toward difficult issues in a welcoming fashion. It expands our capacity to listen and to become aware of the piece of the mosaic that might be missing from our own and the collective understanding."*

For students to effectively explore questions for which there is no obvious answer and develop a deeper and shared understanding of the complex issues and challenges they face in agrifood and forestry systems, being able to introduce and facilitate dialogue is essential. Dialogue provides a safe space for exploring and challenging the assumptions behind our thinking. As opposed to debate and discussion, dialogue takes the energy of our differences and channels it toward something that has not been thought of before. It is a powerful approach to transforming the quality of conversation and stimulating breakthrough thinking. According to Isaacs (1999, p. 19):

> *"The roots of the word dialogue come from the Greek words dia and logos. Dia means "through"; logos translates to "word", or "meaning." In essence, a dialogue is a flow of meaning".*

According to Francis et al. (2016):

> *"We are most often trained to communicate in a polarized manner, in a debate or discussion format, where the main goal is to win, to show that your thinking and arguments are better than those of your opponent. Dialogue-based communication is found in the other end of the communication continuum. Here the aim is to explore a topic together and to create a space for collective learning. The described shift in mindset represents an important prerequisite for developing the skill of dialogue. And, as for all skills, it needs to be practiced, not just talked about. To communicate in a dialogic manner implies an ability to actively listen both to fellow students, to teachers and to people students meet in the case studies, as well as the ability to express one's own experience and pre-understanding without forcing them on others. As teachers guiding the students' exploration, we try to be sensitive to their ways of expressing their experience and to ask them questions that can lead them on to new insights. It implies an open attitude towards seeing and promoting the students' activity in exploring phenomena."*

Being in dialogue differs from being in discussion and debate in several ways (Ellinor and Gerard, 1998, p. 21).

Dialogue	*Discussion/Debate*
Seeing the *whole* among the parts	Breaking issues/problems into *parts*
Seeing the *connections* between the parts	Seeing *distinctions* between the parts
Inquiring into assumptions	*Justifying/defending* assumptions
Learning through inquiry and disclosure	*Persuading, selling, telling*
Creating *shared* meaning among many	Gaining agreement on *one* meaning

In most meetings we use the discussion or debate format for communication, also in situations when dialogue would be the more effective. Dialogue can increase our

capacity to listen for understanding, to listen for the piece of the mosaic that might be missing from our own and the collective understanding, which might be key to a decision or to successful implementation. In order for this to happen, there has to be a shift in some attitudes and behaviours.

According to Hannevig and Parker (2012, p. 20), dialogue requires a shift in our thinking from:

Debate/discussion		*Dialogue*
• Finding errors in others viewpoints	to	seeing value in others viewpoints
• Having to feel competent	to	being vulnerable
• Defending opinions	to	discovering new perspectives
• Drawing conclusions	to	deepening understanding
• Judging	to	searching

In parallel to the distinction between three different forms of knowledge proposed by Aristotle, we can also discern between three different form of talking together. A further insight into the purpose of the three forms – debate, discussion and dialogue – will help us to choose the appropriate approach in different situations.

Familiarity with guidelines which support dialogue and being able to identify questions which are best served by dialogue are equally important. Introducing guidelines for dialogue and giving a group the opportunity to practice them over time in connection with relevant issues and challenges, increases the probability of experiencing the potentials of dialogue.

The following are examples of guidelines which enhance dialogue (Pool and Parker, 2017):

- Be curious – ask questions with genuine interest
- Assume that many people have pieces of an answer
- Search for strengths and value in others´ positions
- Listen without thinking about a response
- Suspend your need to defend your own opinions
- Question your own assumptions
- Slow down – allow for time to reflect
- Leave your role or position outside
- Listen to yourself, the others, and the connections between the various perspectives
- Suspend judgement
- Allow for multiple perspectives without needing to label or resolve them

In the MSc programme in agroecology at NMBU, dialogue is introduced through a one-day workshop, and is then used as the format for the small-groups conversations throughout the semester. In addition, the students also report that they use dialogue as the format for their shared reflections during case-work. Observation is important in dialogue as well. We learn by observing our own thinking and the assumptions behind our thinking. Also reflection is important in dialogue, a process that can be described as a process of reflecting together.

In order to identify questions which might be best served by dialogue, we suggest students ask themselves for example (Pool and Parker, 2017):

- What do we now need to have a shared understanding of in order to succeed in our case work?
- What could benefit from some radically new thinking?
- If there were one core question behind all the challenges we are facing, which question might it be?
- What are the questions we never ask ourselves?

And to test whether a question will inspire the use of dialogue as an approach, the group can ask:

- Is it a genuine question, a question to which we really don´t know the answer?
- Is the question relevant to our real life and work here?
- Does the question generate imagination and feel meaningful?

According to Ellinor and Gerard (1998, p. 21),

> *"The main question to ask yourself when you are wondering if the conversation is more dialogic or more discussion-based is whether the main intention of those taking part in it is to push towards closure and choose one perspective; or, if it is primarily to learn from each other and build shared meaning that includes all perspectives".*

Dialogue is a vital and core competence for action learning. Dialogue should therefore be exercised in the classroom prior to the onset of student teamwork, and then continuously practiced throughout the student course. Observation and reflection are also reinforced in dialogue: – we learn by observing our thinking and the assumptions behind our thinking and we practice reflection by slowing down the pace of the conversation and listen for understanding and new insights. In the MSc programme in agroecology at NMBU, dialogue is introduced through a one-day workshop, and is then used as the format for the small-groups conversations throughout the semester. In addition, the students also use dialogue as the format for their shared reflections during casework.

4.6 Visionary thinking

The competence *Visionary Thinking* is described as follows in the description of how to do "Self assessment of core competences", published in the Nextfood D2.1: Action Research Protocol:

> *"Visioning is the process whereby we activate our insight and imagination, connect with our values and sense of purpose and create mental images of a desired future state. Being able to engage a group in creating a shared vision can heighten the possibility for breakthrough solutions and unite and provide the link between diverse people, interests and activities."*

Despite the fact that change efforts require a high level of engagement from those affected by the change, learning how to engage a diversity of stakeholders in creating a shared vision around a critical societal challenge is not a part of university curriculum. Over 20 years ago change expert John Kotter (1996, p 8) wrote:

> *"Without an appropriate vision, a transformation effort can easily dissolve into a list of confusing, incompatible, and time-consuming projects that go in the wrong direction or nowhere at all. And further "Without a vision to guide decision making, each and every choice employees face can dissolve into an interminable debate. The smallest of decisions can generate heated conflict that saps energy and destroys morale. Insignificant tactical choices can dominate discussions and waste hours of precious time".*

According to Kotter (1996), large-scale change is rooted in what he calls a change vision, a picture of how the stakeholders view their situation after the change has been made. We believe that being able to create and align a team or group of stakeholders around a future that matters is one of the most persistent challenges students of agri-food and forestry systems will face.

A shared vision unites and provides the link between diverse people, interests and activities. Shared visions are expressions of what people have in common; of what they are committed to. When a shared vision has been authentically created, refined and communicated, the normal barriers and roadblocks to implementation fall away. Silos and "us v. them" mentalities lessen, replaced by commitment, communication and action. People with shared vision are more likely to take responsibility; they are more likely to challenge the bounds of convention.

Thinking in a vision-oriented manner supports a divergent approach to thinking and allows a team to fully explore and discover more possible futures. Visionary thinking stimulates the full functioning of the brain, allowing access to mental images and intuitive knowing. A team with a shared vision can more easily grasp the whole picture and how all the pieces are interconnected. Using divergent and convergent thinking in the right ways, and at the right points in the process, stimulates creativity and allows for the possibility of breakthrough solutions. In order to create a shared change vision, students need to learn how they can activate their insight and imagination, connect with their values and sense of purpose and create mental images of a desired future state relevant to the challenge that is in focus.

Visionary thinking is a highly versatile approach, one that can be used in many different situations and with different time horizons, all depending on the interests of those engaging in the visioning process. Examples of opportunities for envisioning change are unlimited. Examples from NMBU of what has been the focus for shared visions

created by the students in the classroom and in collaboration with stakeholders in the field have been:

- The ideal team-work
- The user-friendly stakeholder document
- The regenerative farm
- The future desired collaboration between farms
- The sustainable county food system
- The desired urban agriculture activities in a city
- Organic food in public kitchens – the ideal situation

Once the focus of the visioning activity has been set, laying the groundwork includes creating the right environment, familiarising participants with the process, and posing questions that free the imagination and stimulate the flow of imagery. In the shared visioning approach, the implementation-planning phase in the change process becomes a learning process in which perspectives must continually shift between the shared vision and the immediate actions that are needed to reach it.

In the MSc agroecology programmeat NMBU, visionary thinking is introduced in a three-day workshop preceded by previous workshops on reflection and dialogue. The aim is giving the students hands-on experience with visionary thinking as preparation for facilitating the creation of shared visions followed by planning for implementation with farmers and other food system stakeholders.

The methodologies for creating shared vision and a description of the process used at NMBU are described in the book Creating Futures that Matter Today – Facilitating change *through Shared Vision* by Pool and Parker (2017).

The importance of vision in an educational setting is underlined by Hord (1997, in Huffmann, 2003), saying that "vision is a concept in a learning community that leads to norms and behavior that have a primary focus on student learning and are supported by staff members". DuFour (1998, in Huffmann, (2003)) summed up their findings on the function of shared vision as follows:

> *"The lack of a compelling vision for public schools continues to be a major obstacle in any effort to improve schools. Until educators can describe the school they are trying to create, it is impossible to develop policies, procedures, or programs that will help make that ideal a reality …. Building a shared vision is the ongoing, never-ending, daily challenge confronting all who hope to create learning communities".*

4.7 Facilitation in education

What is facilitation in an educational context?

Facilitation is a term to describe a possible role of the teacher. Facilitating learning is to provide the necessary resources, information and support in order for students to complete a task, rather than teaching through solely delivering information.

As educators, how we communicate with our students and other members of the learning community is at least as important as the content we want to share. Often our attention is focused almost only on the material and not by far enough on how we can engage and stimulate the students to embrace and practice new competences and make changes in behaviour and learning styles (Wise and Ezell, 2003).

As educational philosophies have developed, beliefs and pedagogical practices have changed to accommodate the richer experience and knowledge that learners bring to the classroom. The role of teachers has moved from acting as the "sage on the stage" and instead, to begin supporting or framing the learning that is meaningful for each student, e.g. acting as the "guide on the side". Traditional approaches are not successful in developing the 21st-century skills that learners need (e.g., critical thinking and the ability to communicate effectively, innovate, and solve problems through negotiation and collaboration). Research consistently suggests that collaborative learning and personalised learning strategies are more effective in supporting the deeper learning needed (Wise, 2017).

While teaching methods will vary to some extent depending on the subject, level of learning or intended outcomes, the focus is generally on helping learners gain new competences and understand course content through questioning and suggestions while providing rich cases, complex problems, and opportunities to apply new knowledge in different contexts.

Training facilitation

For the educator, facilitation is part of the selection of methodologies that researchers and students can adapt to the uniqueness of their learning setting. Facilitation is a competence that is best developed through practice. In the classroom, the teacher as facilitator is fundamental, for example when developing learner-centred work, communicative activities and social approaches. As facilitators we need to establish an environment of trust, so that students feel safe and comfortable to participate with their perspectives and knowledge. A way to do this is to set off time when a new group come together for ice-breaking activities and to train dialogue as a competence when communicating, encouraging all to actively listen as well as join in. In order to facilitate in a classroom setting it is preferable to have a room with a flat floor and moveable tables and chairs. If you are in a steep lecture hall or the only space for the teacher is up front, it is hard to move about the room and interact with the students, and they cannot easily interact with each other.

A teacher can facilitate a discussion on, for example ecological principles in farming, by asking students to research the issues for homework, structuring the groups, providing a list of useful concepts and acting as a quick reference for questions. Then the task is to manage the discussion where necessary by facilitating the group processes among the students, so that they learn how to practice it themselves in their future work.

Facilitation as motivation

A motivation for teachers is that teaching through facilitation effectively assists them to help students achieve positive transformation in their learning (Cyr, 2008). The educating staff may also benefit from facilitative approaches when working on communication, relationships and effectiveness in their meetings and administrative tasks (Rilla et al., 2006). With a facilitative attention on preparation and process, these tasks may become both more fruitful and gratifying (Haskell and Prichard, 2004). Both educational staff and students should therefore be trained in facilitation.

Advantages of facilitation

Facilitation skills may be useful when the objective for the session is to generate ideas, to have a dialogue around a common issue, to create a shared vision, to come to a mutual conclusion or to solve a problem (Pool and Parker, 2017). Facilitation may be used for settling conflict, or to deal with conflict-laden matters including developing students' capacity to resolve their own group conflicts. Facilitation is also a tool that can be important in individual learning, in addition to the above mentioned group activities and cases of tension or discord.

In action learning we focus on the learning process and encourage students to become lifelong learners. Facilitation is a good method to practice this. If we communicate this content in a traditional one-directional way, we will not obtain the same results. As such, the much-needed shift in focus, from a more narrow emphasis on theory to a wider competence orientation necessitates a shift from lecturing to facilitation.

Moving from conventional teaching towards facilitated learning has numerous rewards. The students learn to take responsibility for their own learning process and work with the teachers to agree on what theory and competences they need to obtain, rather than the teacher having that concern alone and the task of collecting data and supplying it to the students. A facilitator lends direction to learners in search for their own knowledge. Activities in the classroom can give practice in finding information and reflection on how it can best be adapted to real life settings. Through facilitation everyone can participate in thinking about alternatives and relating these choices to various scenarios and expected results.

When we practice facilitation in the classroom or off-campus with students, it gives them the message that we recognise their contribution to the learning, their expertise, and that the exchange of knowledge takes place among all in the room or other setting. There is a breakdown or relaxation of the conventional hierarchy, and this essentially lifts up the significance of the student in relation to the teacher and enables a fruitful collaboration in the educational process (Wise, 2017).

The students should also contribute to a self-evaluation of the facilitation performance and consider how appropriately key topics have been included and dealt with in the learning activities rather than leaving the evaluation of the sessions to teachers or others, thus sharing the power and obligation to evaluate the process.

Facilitation in educational settings is a powerful tool for transforming learning and makes the interaction so much more than information sharing. Facilitation can empower students and teachers alike to become lifelong learners and thereby leave a meaningful impact on their lives.

5 Systems thinking for practice

Systems thinking is considered by several authors to be an important component of "sustainability competence" (Carlisle et al., 2019; Molderez and Ceulemans, 2018; Nelson and Cassell, 2012). In this section, a brief account of what systems thinking is or can be is provided as a theoretical foundation for developing an educational approach that goes beyond the more widespread and contemporary reductionist paradigm.

Reductionist, linear, disciplinary thinking is very effective in simple situations but insufficient or even inappropriate when confronting complex ones containing wicked problems (Batie, 2008; Herrscher, 2006), for example, due to incommensurable environmental, economic and social contexts and intentionalities (Bland and Bell, 2007) or different understanding of these (Bawden, 1991; Ison, 2008). Thus, the reductionist approach is to be credited for the success in productivity of the agro-industrial-commercial complex, but also to be blamed for its environmental trade-offs (Gliessman, 2015). The following statement, attributed to Albert Einstein, illustrates the need for a different approach:

> *"We can not solve our problems with the same level of thinking that created them."*

The complexity, messiness, wickedness and urgency associated with sustainability challenges (Hays, 2013) require "a transdisciplinary, participatory and action-oriented approach" (Batie, 2008; Méndez et al., 2016) and "looking at things in terms of the bigger picture" (Midgley, 2006), which is a simplistic but useful first approximation of what systems thinking entails. Complexity leadership theory is an example of a school of thought aligned with systems thinking. It acknowledges that leaders are embedded in a complex interplay of several forces and that leaders should seek to enable the creative and adaptive capacity of organisations entangled in such wicked environments. It also holds the view that creative change, innovations and breakthrough ideas are all important emergent outcomes of the complex dynamics of systems (Marion, 2008).

Situations involving agriculture, food and forestry are amenable to this thinking, hence the terms agri-food and forestry systems. Such situations *can be viewed* as social-ecological, purposeful human activity systems or wholes consisting of both bio-geo-physical and socio-cultural components (Becker, 2012). In agreement with this view, Olson and Francis (1995) defined agroecosystems as "integrated social, economic, and ecological systems designed to provide specific commodities and services and having a hierarchical structure with multiple spatial and temporal scales."

Several properties of such complex systems make it difficult for people to understand and work with them:

- Cause and effect are often separated in both time and space.
- Problem resolutions in the short term often cause larger problems in the longer term.
- System parts interact through multiple, non-linear feedback loops, which often results in counterintuitive behaviour.
- Time delays between cause and effect make people become accustomed to situations, which results in reduced ambitions of mitigating what they previously found unacceptable (Forrester, 1971).

Consequently, a systemic approach to these challenges requires capability of understanding interactions between the parts of the system and behaviour over time. Further, it implies capability of dealing with issues between, across, and beyond all disciplines, i.e., transdisciplinarity (Francis et al., 2012).

An early example of systems thinking was given by Darwin (1859), cited by Wilson and Morren (1990, p. 68). He reflected on the relationship between certain flowers and humble-bees, which are essential for pollination, between humble-bees and mice, which eat the humble-bee nests, between mice and cats, which eat mice, and between cats and people, which are both more abundant in villages than in the surroundings. He concluded:

> *"Hence it is quite credible that the presence of a feline animal in large numbers in a district might determine, through the intervention first of mice and then of bees, the frequency of certain flowers in the district."*

More specifically, systems thinking builds on the notion that phenomena and situations *can be viewed* as a cohesive conglomeration of interrelated and interdependent parts (natural or man-made) constituting a whole. The whole is delimited by its spatial and temporal boundaries, is influenced by and influences its surrounding environment, and has a measure of self-regulation. It can be described by its structure and purpose or nature, and is expressed in its functioning. The effects of such a structured whole —a system—is usually more than the sum of its parts due to synergy or emergent behaviour, i.e., that the system as a whole expresses qualities not present at lower levels of organisation. Changing one part of the system usually affects other parts and the whole system (Bateson, 1972; Bland and Bell, 2007; Gliessman, 2015; Ison, 2008; Midgley, 2006). "The systems perspective encourages us to examine how things interact, interconnect, interrelate, or, in some sense, control each other. Systems approaches also share the idea that causality in nature, particularly in the living world, is circular (or recursive) rather than linear" (Wilson and Morren, 1990), which in system modelling is frequently referred to as positive or negative feedback (Cinquin and Demongeot, 2002). A nested structure of a system existing in its supra-system(s) environment and consisting of sub-systems is usually assumed (Bawden, 2005; Bland and Bell, 2007; Francis et al., 2012). The behaviour of a system can be purposive (imposed purpose) or purposeful (willed purpose) (Ison, 2008). Bland and Bell (2007) elaborated on Arthur Koestler's holon concept. In their interpretation "[…..] a holon is bounded by its intentionality to persist, and the imperative to do so in multiple, incommensurable, and ever-evolving contexts motivates [……] change. A farm and an animal, because they have intentionality (conscious or not), are examples of holons. A tractor, because its purpose is imposed from its surroundings, is an example of a system not considered a holon.

The general concepts are shared by three commonly recognised "schools" of systems thinking: "hard", "soft" and "critical" (Bawden, 2005), which may be distinguished by their paradigmatic foundations (Jackson, 1982) and be viewed as different sequential "waves" of thinking (Midgley, 2000). From a methodological pluralist position of critical systems thinking and systemic intervention (Midgley, 2006), the "hard" and "soft" systems thinking may also be viewed as sub-sub- and sub-systems, respectively, which have much to offer if used appropriately and with critical epistemological awareness (Bawden, 2005, see below). For an overview of how the history of relationships between different schools of systems thinking can be perceived, see Ison et al. (1997).

Briefly and roughly, in the sequential "waves" model (Bawden, 2005; Midgley, 2000, 2006), puzzle solving is the pre-scientific or early scientific attempt of finding out what is this and how does it work. Scientific activity then typically focussed on solving problems in situations where relatively simple, linear causal relationship was assumed; in reductionist science we searched for how to fix it or make it effective. The first "wave" of systems science focussed on optimising items or situations where the existence of non-linear, complex causal relationships and feedback mechanisms was acknowledged; this is 1st-order cybernetics, hard-systems or systematic thinking focussing on system dynamics and the question of how to make things work more efficiently. The farming system research tradition considering the analyst an external, objective observer modelling the system, usually in quantitative terms, is an example of this first "wave" of systems thinking. In the second "wave", it was acknowledged that when people's different worldviews and interests add to the complexity, optimisation is hardly possible and, therefore, that focus should be on improvement or "satisfycing"; this is 2nd-order cybernetics, soft-systems or systemic thinking for learning how to make things better). Example of this thinking is participatory action research in which the researcher is viewed as an internal actor and observer participating in systems learning: the collective finding out about how things are, how they should be, how to make them happen and how the agreed-upon actions worked out. The third wave of systems thinking is critical systems heuristics, or critical learning systems; this 3rd-order systems thinking is characterised by an increasing awareness of power relations and, hence, the importance of boundary critique, e.g., whom to include in the "system of interest". Further, there is more emphasis on epistemological awareness and reflexive thinking about how we as individuals and as a collective learn. For an overview of the major differences and similarities between the reductionist, hard-systems and soft-systems and critical systems approaches, see the cited references (Bawden, 2005; Ison, 2008; Ison et al., 1997; Midgley, 2006; Wilson and Morren, 1990).

A simple, constructed example may aid understanding of the difference between these approaches. A person not having seen a car before (however unlikely this is nowadays) might start by trial and error to find out first what it is, next what it may be used for, and then how to start driving it. If the car stops working, the driver may take a more targeted, perhaps focussed approach to solving the problem and make the car work again. The next step might be to optimise the car's functioning, e.g., the fuel use efficiency, by fine-tuning the complex interactions between several car components. Then, if the driver's goal is to take his or her family on holiday by car, the family members' interests obviously go far beyond optimising fuel use efficiency. Technical matters, ranging from problem solving to optimising, may still be part of the problematic, but negotiating between more or less discrepant views will probably be necessary to have a reasonably good family holiday. The more experienced family holiday stakeholders may eventually develop an individual and joint reflection on the interaction between family members in such a situation and the process by which they as a collective *deal* with it. If taken to proficiency, the process by which the family as a whole *learn* to deal with challenges is also reflected on.

The generic nature of challenges in natural resource management described above— from farm or forest to global levels— are similar to those faced by a family on car holiday. It is obvious that there is a need for schools of systems thinking and practice (Bawden, 2005; Ison et al., 1997) representing a holistic, trans-disciplinary approach where both bio-geo-physical and socio-economic components and processes are considered (Gliessman, 2015). In agreement with the concept of system, sub-systems

and supra-systems hierarchies (Olson and Francis, 1995), Bland and Bell (2007) envisaged every farm or agricultural environment (agroecosystem) to be a whole (holon) that contains many layers (smaller holons or parts) and is itself part of larger entities (themselves holons). They launched the term "flickering" as a conscious process of focussing on the whole and the parts, respectively. They made the point that boundaries of a holon, e.g., a farm, must be considered porous and irregular as its setting will dependent on which "context" is in focus. They further argued that the "ecology of contexts"—i.e., the set of more or less incommensurable internal factors and concerns—and the set of intentionalities—e.g., interests of different stakeholders—is so complex and dynamic that it is impossible to perfectly characterise a system, let alone optimise it. "Flickering", which is consistent with multi-dimentional and multiperspective thinking (Olson and Francis, 1995; Rickerl and Francis, 2004) may then be seen as a systematic attempt of compensating for our generally poor ability to perceive wholes and parts simultaneously.

In recognition of the difficulty associated with accurate characterisation of complex systems within complex "contexts", Bland and Bell (2007) considered holonic thinking as "[…..] a way to tell stories about the world. It is not the world itself. (Nothing but the world can make that claim.)" Thus, systems thinking can more fruitfully be considered a way of viewing the world by means of analytical constructs rather than an activity producing accurate descriptions or models of how the world is (Ison, 2008). "The systems perspective says only that it is useful to view the world *as if* it were composed of systems" (Wilson and Morren, 1990). It can be conceived as a mental attitude to improve our understanding of the real world and our ability to act within it rather than a way of producing a perfect theoretical characterisation or model (Checkland and Poulter, 2006). Hence, the ultimate purpose of the systems perspective is practical (Herrscher, 2006). Given the practical purpose of systems thinking, the *as if* approach obviously does not mean surrendering to radical constructivism, which would probably be no better than leaning entirely on the much criticised reductionist paradigm. It is important to acknowledge, though, that "it is biologically impossible to have a shared experience—all we have in common is language" (Ison, 2008). Bawden (1991) pointed at the importance of ways of seeing ("window on the world"; "Weltanschauung"/worldview) for how we think and act. The systems language may then be viewed as a means of communicating our individual perceptions and interpretations in order to improve our understanding of messy situations and to take informed actions for their improvement (Checkland and Poulter, 2006). This ideally encompasses both 1st-order thinking (about what we understand about the situation; cognition), 2nd-order thinking (about how we come to understand the situation; meta-cognition) and 3rd-order thinking (about the nature of and limits to knowing; epistemic cognition) (Bawden, 2005; Ison, 2008).

It is important to recognise that the need for more advanced inquiry approaches when "addressing wicked problems does not equate with abandoning normal science. Instead, it is an argument to allocate more of the discipline's resources to wicked problems. ["……."] Many of the same tools and concepts used in addressing simple or 'tame' problems will be used in addressing wicked ones. Normal science can be used to address the "what is" and "what if" components of both wicked and tame problems" (Batie, 2008). For instance, the relationship between the more or less reductionist and systematic, hard-systems approach on the one hand and the systemic, soft-systems and critical learning systems approach on the other, may be considered a *dialectic* instead of a *dualism/dichotomy* (Bawden, 2005; Francis et al.,

2012; Harrop et al., 2012; Ison, 2008; Lane and Oliva, 1998; Lieblein et al., 2007; Rodriguez-Ulloal and Paucar-Caceres, 2005). In the model of sequential "waves" or stages of intellectual, moral and epistemic development the stages may be viewed as "hierarchically integrated such that the structure of each successive stage differentiates and reorganises the knowledge constructed at the previous stage'' (West (2004), quoted by Bawden (2005)). To fully draw on the diversity of approaches, methodologies and methods available to systems thinkers and practitioners, there is a need for the methodological pluralism and epistemological awareness that are among key characteristics of systemic intervention or critical systems thinking (Bawden, 2005; Midgley, 2000, 2006). The "flickering" suggested by Bland and Bell (2007) regarding the relationship between parts and the holon, might be a useful mental model for juggling different approaches within the overall systemic approach. They likened the hitherto most common conceptual and methodological approaches with a ladder and gave the following reason for adding the holon concept: "[….] we worry that we often reach beyond the safe height of [the] conceptual ladder", but added: "We do not ask for banishment of simple systems thinking, then. There are times when a shorter ladder is just what is needed." This is in agreement with the concept that researching or learning systems can be viewed as a "spiral" of hierarchical levels, for example, with an overall systemic approaches at the top and hard-systems, reductionist-technology, reductionist-science inquiry methods at levels below (Bawden, 1991), all of which may be understood in terms of Kolb's (1984) cycle for experiential learning, which is an important point when developing action learning for sustainable development. Such reflection on methodology may be termed "systemicity in the methods of enquiry" (Bawden, 1991) and 3rd-order, epistemic cognition (Bawden, 2005). Interestingly, for learning at the personal level, Baker et al. (2012) depicted Kolb's (1984) "Experiential Learning Theory of Growth and Development" as a cycle in the horizontal dimension representing the experiential learning process and a cone in the vertical dimension representing increasingly higher-order integration and consciousness, which is similar to the increasing involvement and epistemological awareness when moving from reductionist or hard-systems approaches to systemic intervention and systems learning.

The soft-systems methodology (SSM) of Peter Checkland is an example of a systems inquiry approach recognising both the complexity of system components and their interactions as well as stakeholders' different views on the world, both contributing to the "wickedness" of a problematic situation (Checkland and Poulter, 2006). A most significant contribution is that not only is the current situation viewed as a purposeful human activity system, but activities to transform the current situation to the future wanted one is also modelled as human activity systems in which worldviews are recognised. This implies intentionality and, thus, justifies the conceptualisation of a learning system (Bawden, 1991) including stakeholders and other parts that constitute a supra-system that is a holon (Bland and Bell, 2007). Technically, SSM is a stepwise process, which often is addressed in a workshop format. Midgley (2006) summarised it as follows: "(1) Consider the problem situation in an unstructured form; (2) Produce a "rich picture" (a visual representation—with pictures and arrows to represent links between issues—of the current situation); (3) Identify possible "relevant systems" that might be designed to improve the situation, and harmonise understandings of these by exploring who should be the beneficiaries of a proposed system change, who should carry it out, what the transformation should be, what worldview is being assumed, who could prevent the change from happening, and what environmental constraints need to be accepted; (4) Produce a "conceptual model" for each relevant

system (a map of the interconnected human activities that need to be undertaken if the system is to become operational); (5) Refer back to the rich picture to check the feasibility of the ideas; (6) Produce an action plan; and (7) Proceed to implementation."

Thus, the process does not stop, for example, with a systems analysis of the current and future wanted situations, but focus is moved to the system of actions that need to be undertaken. Such a transformation system or sub-system each can be identified by a "root definition" expressing *what* should be done, *how* it should be done and *why* it should be done, which is a device to ensure consistency of means and each activity system and the whole action plan modelled as a human activity system consisting of interconnected sub-, sub-sub-systems etc. Apart from being a planning tool, such modelling of transformation systems is viewed primarily as an epistemological tool to create dialogue between stakeholders having different interests and worldviews (Checkland and Poulter, 2006). As SSM acknowledges different worldviews and the need for stakeholder analysis, in principle, the methodology opens for considering power relations. However, critical system heuristics with its boundary *critique* and considered to belong to the third "wave" of systems thinking has a more explicit take on this issue (Midgley, 2006).

Wilson and Morren (1990) noted that SSM is consistent with the pluralist position regarding inquiry methods and identified step 4 as the stage to "spiral" into other inquiry approaches or levels, e.g., hard-systems or even reductionist ones. They also superimposed the SSM process on David Kolb's (1984) cycle for experiential learning, which emphasises the view of soft-system inquiry as a process of collective experiential learning or research.

6 Institutional prerequisites

Higher educational institutions have a unique position in educating future sustainability leaders of the world. This calls for universities that strive to change their current structural systems to try to overcome obstacles to achiev the necessary changes. Along with the many initiatives driven by the members of the Nextfood consortium, there are other examples of ambitious sustainability education projects, for example the Transforming Higher Education Project, involving the Earth University in Costa Rica and the American University of Beirut. Although these projects are valuable, we need to move from isolated initiatives and good examples to a more coherent approach with potential to strategically affect the higher education sector on a global scale. Also, it is important that an effective network among those committed to learning for change in these often separate initiatives be developed and supported in order to share good practices.

6.1 Barriers for faculty

Nextfood took part in a discussion on barriers to transforming higher education at the 10th GCHERA Conference on "Transforming Higher Education" in October 2019. Obstacles that were brought up for discussion were related to the culture at the teaching institution:

- Currently faculty members are worried that if you make the transformation you will throw the quality out of the window.
- Faculty continues to focus on theoretical content alone rather than on learning
- Universities have a long tradition, were established with lectures, and are difficult to change

6.2 Barriers for students

Barriers are also connected to the attitude of the students:

- Students are often too shy to actively take part in discussion
- Critical thinking too often is not trained nor encouraged
- Some students may have insufficient motivation to be active learners, and may be more interested in theoretical knowledge acquisition only rather in competence development

6.3 Barriers for institutions

Lastly, some of the barriers are more related to governance and the policy level:

- How education is funded: if students pay high fees, then they want to get their degree as fast as possible and may be less interested in learning; as a consequence. We produce students not being ready for work life.
- Curriculum are more designed by the government and not by the university
- Rankings of universities does not include students' learning experiences, nor how the university contributes to the community
- Europe is a mosaic of cultures, with huge variation in learners and ambitions, and therefore education has to be agile and adaptive to students' needs.

6.4 Transformation to sustainability education

To reach impact beyond the consortium, Nextfood aims to identify and overcome institutional barriers that that can hinder effective faculty collaboration for transdisciplinary and action-oriented education. Institutional factors are connected to central values and attitudes about how higher education should function, and how these values are maintained. Thomas (2004) highlighted in a review the need for a strategic approach, based on organisational change management and staff development, to develop the curricula in higher education institutions to include sustainability education. After reviewing a number of empirical studies that investigated the factors acting as barriers to actively implementing such curricula change, they summarised the common threads coming from these studies as:

- a lack of a culture of value or priority given to greening and sustainability;
- a lack of organisational and resource support for staff
- a lack of training for academic staff.

Thomas (2004) concludes that initially, many efforts were made to develop sustainability courses and produce teaching materials, now the challenge is to bring about change in the system and the culture of the organisations themselves. The need to support academic managers and enable staff, faculty and students with sustainability skills are also highlighted by Cortese and Hattan (2010).

Evans (2015) describes the need to collectively create a transdisciplinary praxis for sustainability education in colleges and universities, and discuss the importance of faculty to develop collaboration among themselves. In the study the institutional factors were analysed, including organisational structures, culture and processes that influence positively or negatively the work for introducing sustainability education. One such factor is the rigid structure of academic disciplines that effectively hinders the integration of knowledge from different fields and its focus on generating theoretical and abstract knowledge rather than knowledge that can be applied to real-world problems. Another factor is the negative effect on the career that faculty members perceive as a risk when engaging in transdisciplinary projects, instead of focusing all efforts on one academic discipline. These and other factors make up the “hidden curriculum” that builds on ideas and assumptions that are widespread on campus and sometimes uncritically overlooked by students and faculty members.

Mader et al. (2013) identified a number of challenges that sustainability leaders will have to deal with in seeking to build sustainability in core processes of universities. For example convincing faculty that any course, no matter the subject, can have a sustainability approach, and that a major barrier is the prevalence of a reductionist, neo-liberal, technocentric paradigm that prevails in the academy worldwide. Mader et al. (2013) suggest that management and governance systems in higher education which have successfully given sustainability a more central role in universities and colleges should be identified. And we need to find effective ways to engage senior leadership with giving sustainability a more central focus in the university’s core activities and operations. It is also important to find robust evidence that taking a transdisciplinary approach to higher education is going to be more productive for people and planet than a collection of mono-disciplinary activities.

In an extensive literature review, Chiong et al. (2017) identified eight main factors that drive sustainability integration in institutions of higher education. Some factors were

related to the educational setting; integration of sustainability into the curricula, student-centered and action-oriented pedagogy, activities raising the awareness for sustainability and community outreach programs that contribute to the understanding of the problems that the community faces and inspire students to engage in solving real-world problems. Action research has been valuable for teachers developing their teaching and for students connecting theory to practice. Managing the campus itself in a sustainable way to encourage sustainability integration and building trusting collaboration and encouraging participation are necessary to build a sustainable culture at campus.

It is necessary that sustainable education becomes a core mission of higher education institutions and that academic leaders reconsider the educational strategy, embracing a more integrated and holistic approach and co-curricular activities on campus and in the community (Cortese and Hattan, 2010). Whereas bottom-up leadership and change initiatives driven by students and faculty are crucial to achieve the necessary change, top management leadership support is important to gain broad support and accomplish larger, more revolutionary educational transformation (Lee and Schaltegger, 2014). A way forward is the application of organisational learning theory that can help people challenge their assumptions and worldviews and develop new practices, and through this contribute to better understanding of the process of transformation towards sustainability in higher education (Cebrián et al., 2013).

7 What are the necessary shifts towards the Nextfood approach?

a. *Two overall shifts*

- From teaching to learning
- From knowledge to competence

b. Building a bridge between academia and the 'real life' (in society)

c. Five areas of specific shifts

Student-centred and action-oriented learning in a sustainability perspective is characterised by a shift:

- ✓ from the lecture hall to a variety of learning arenas
- ✓ from lecture to co - and peer learning
- ✓ from syllabus to supporting literature
- ✓ from textbook to a diversity of teaching aids/multiple sources of knowledge
- ✓ from written exam to a diversity of methods for assessment

These shifts have implications for how we view ourselves as teachers, *as lecturers or learning facilitators*.

8 What does the Nextfood approach require from teachers, students, and institutions?

8.1 From teachers this requires:

- Giving away control (of content)
- Stepping out of comfort zone
- Being willing to take risks
- De-constructing and re-constructing professional identity (from lecturer to learning facilitator)
- Moving from subject matter (theory) to giving primacy to lifeworld phenomena
- Having basic knowledge of factors that enhance student centered learning
- Having access to colleagues with more experience for mentoring

8.2 From students this requires:

- Shifting from passive to active role
- Taking responsibility for their own learning process
- Being willing to interact with stakeholders in the field
- Accepting uncertainty, complexity, incomplete knowledge
- Being part of a change process in the field
- Accepting open mindedness
- Willingness to try out new ways of working/learning

8.3 From institutions this requires:

- Leave space in the curriculum for transdisciplinary learning activities
- Value faculty members who teach outside their own department and their own discipline
- Awareness of that cutbacks often hit harder on programs that are innovative and in less established disciplines
- Enabling a distributed leadership that promotes a sense of common purpose and shared commitment
- Supporting transdisciplinary faculty development as well as transdisciplinary research
- Include faculty and students in discussions about sustainability values
- High-level management support is needed because sustainability education may challenge the status quo and established power relations
- Provide education that is highly accessible to all, no matter gender or social background of students

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