Understanding the difference

Responsive education: A search for 'a difference which makes a difference' for transition, learning and education

Dr. Frank P.C.M. de Jong

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Responsive education: A search for 'a difference which makes a difference'[1] for transition, learning and education

Het verschil doorgronden

Responsief onderwijs: Een zoektocht naar 'een verschil dat het verschil maakt' voor transitie, leren en onderwijs

Dr. Frank P.C.M. de Jong

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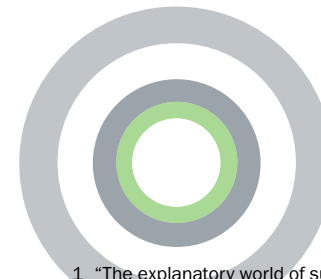
1   "The explanatory world of substance can invoke no differences and no ideas but only forces and impacts. And, per contra, the world of form and communication invokes no things, forces, or impacts but only differences and ideas. (A difference which makes a difference is an idea. It is a 'bit', a unit of information)" (G. Bateson, 1972, p.276); "(…) information may be succinctly de-fined as any difference which makes a difference in some later event" (p 386); "Difference which occurs across time is what we call 'change' "(p.458).

2   Starting September 1, 2016, the new name is Aeres University of Applied Sciences, faculty of Professional Learning, Development and Teacher Education.

Colofon

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Foreword for 'Understanding the difference'

Three beginnings

Reducing the ecological food footprint, feeding nine billion people by 2050, boosting social and community involvement in the agri-food sector and working on the 'new' economy with new business models based on the principle of shared values are urgent topics: these issues concern fundamental change which is not achieved by optimising or repairing traditional, non-sustainable systems. After all, if you do what you did, you get what you had. But what is needed in order to bring about fundamental system changes that contribute to the development of an innovative, reflective bio-based society, a circular economy in which shared values, technological developments, new scientific insights about learning and social innovation together will be a powerful catalyst. These questions will be looked at from five perspectives: the production side (circular economy), consumption (health and wellbeing), environmental dynamics, entrepreneurship and new business models, and the different paradigms that are needed in education. What characterises the future player, what does he/she need to be able to contribute to the intended transitions, and which instruments (traditional and unconventional) should he/she have? How do we equip the future student – definitions of which vary – to handle complex issues in order to give them direction and a course for the future.

As education has an important role in learning to think, education itself should think about a transition too, and work on its responsiveness. The development of this 're-sponsive education' is part of the Stoas Wageningen | Vilentum University research programme, and falls under the professorship of Frank de Jong.

On 19 March 1951, Mark Rothko – the famous American painter – said at a symposium at MoMA New York: 'I realise that historically the function of painting large pictures is painting something grandiose and pompous. The reason I paint them, however, … is precisely because I want to be very intimate and human. To paint a small picture is to place yourself outside your experience... However you paint the larger picture, you are in it.' (2014, catalogue Gemeentemuseum Den Haag). For that reason, he hangs the paintings low on the wall. Because you are so close to it, the impression is created that you are part of the work. As Joost Zwagerman (2015), a

well-known Dutch writer, put it: Rothko wanted to bridge the gap between the painting and the viewer to take a more direct, intimate, deep emotional meeting between the two effects. His work expresses no experience but IS that experience. With this way of thinking and working, Rothko gives meaning to the nature of the relationship between viewer and painting.

For Frank de Jong, this is exemplary for his argument that looking into a theory is like looking into any other conceptual artefact. A further search for the differences brings him encounters with ecological intelligence, Bateson's view of relationships as the ecologies of differences that lead to reciprocal response, a reinterpretation of manifests of learning, and last but not least his own research on and our common experiences with knowledge building over the last nine years. Finally, he argues that three beginnings form the bases for the development of responsive education, education that could make the difference for the transition in the green domain.

Madelon de Beus
Director

Part 1
Ecological crisis and thinking

Introduction

About thirty years ago my wife and I avoided the use of plastic bags and packaging. Since then I have never seen so much plastic pre-packaged products in the shops as nowadays. We also decided to buy ecologically produced food in eco-shops. You see a lot more ecological or bio-based products in the supermarkets nowadays. We produced vegetables in our own garden together with friends. My wife is still doing so, and each summer we enjoy the mass of beans, pumpkins, beetroots, flowers, etc. This is a kind of life awareness and behavioural decisions which Greenpeace currently advises to consumers at the end of its report 'Food for life, ecological farming seven principles manifest' (Greenpeace, 2015). Examples of this are deciding what to buy, composting at home, work and your city, growing food yourself by planting herbs on balconies and terraces. And last but not least, making consumers demand that private companies, governments, donors and politicians invest in ecological farming. It sounds a bit like the statement 'improve the world, start with yourself' of the 60ties and 70ties which sometimes contributes to change and sometimes does not change much more than yourself. A humanistic belief of man as the centre of the universe.

Furthermore, the EU report on nature-based solutions & re-naturing cities (EU, 2015) mentions a growing interest and awareness within the business community of the value of managing and maintaining biodiversity and ecosystem services as a business opportunity. It is described as the essential means to reduce economic risk by ensuring the continued supply of vital resources. The EU report focuses on enhancing sustainability (also in city life), restoring degraded ecosystems, adapting and mitigating climate change and improving risk management and resilience. To achieve this it looks to the development and deployment of nature-based solutions, new business and investment models and frameworks, and empowerment of citizens. But at the very foundation of realizing these ideas is the way we think and how we learn to think. Oddly enough the place where we learn to think in a particular way, e.g. education, is not included in the scope of these reports.

Therefore we have to search in the educational community for whitepapers such as: 'I, we and the world about sustainability education' (Programma Duurzaam-Door, 2015). We can see a focus on content such as biodiversity, water, food, natural resources, energy, environment, etc. Pedagogical approaches are also men-

tioned such as teaching and developing affection, wonderment and value formation; system thinking, critical reflection, value formation, handling complexity, problem solving and even didactical approaches such as activating didactic and authentic out-of-school learning are also described. I also encounter these pedagogical approaches and learning activities in other school learning which is not concerned with 'learning for sustainability'! So what makes the difference?

There are lots of definitions of nature based, re-naturing, sustainability, authentic learning, out-of-school learning. These are linked to concepts of other movements such as 21st century skills such as flexibility, critical thinking and reflection, system thinking, evidenced based, people-planet-profit, agro-ecology. Reading the documents, it is striking that generally the words are mentioned, without any reference to the existing body of knowledge and theories in the learning and educational sciences.

All these reports are aimed at changing the behaviour of consumers, policymakers, managers and students. This is, of course, very valuable in the pursuit of building a world where fundamental needs such as diversity of life on earth, food for everyone, food security, clean water, safety, protection of wellbeing and living, are sustained and restored in balance with nature. A world where control is held by local communities with nature and people at the heart of the system rather than by a few transnational corporations.

It would have been obvious to start at the point where I ended in my inaugural address nine years ago, e.g. learning and knowledge creation. I will pick up here, but with a different perspective. I actually started with a personal history so that you get to know the author a bit better. The Frankfurter Schule has already taught us that knowledge is always coloured by the background and ideas of the connaisseur. And I started with learning from the behaviour of my wife and my own behaviour and our decisions in daily life 30 years ago. In the words of Engeström in his key note at EARLI 2015: "*Learning is not only a change in mind but also in the daily life of actions.*" Actually I also started with one of the opening slides of my speech nine years ago 'from an industrial to a knowledge society', asking myself: "*does there exist an educational process that can develop knowledge workers with skills that can be achieved to maintain the prosperity and well-being we have today in a way that 'sustainable' progress is realized?*". Education has the potential to make a

substantial contribution to a different world, but it is it realizing this enough? Taking my wife's and my behaviour 30 years ago and my view on education nine years ago, what are the differences with the approaches and views in the current reports? What difference makes a difference for another practice so that in nine years time at the end of my working life the world will have started to become a safe, prosperous, spiritual place, with well-being for all its inhabitants?

Emergent interconnected problems

As I have already said, I see more plastic pre-packaged products than ever in the shops. I don't need to mention all the other things that are becoming more complex, more global and more urgent. These emergent developments are the reason why the Dutch Ministry of Economic affairs is supporting five professoriates in transition in the food and agricultural sector[3] of which responsive education is one. So let's look at an example of the context of these five professoriates: food, an everyday necessity. According to Greenpeace, we produce enough food to feed the seven billon strong global population. This is enough quantitatively speaking. However, you and I can choose what we eat at least three times a day and 1.5 billion of us make choices that lead to us becoming overweight, with 500 million of us obese (Finucane et al., 2011 cited in Greenpeace, 2015). This while about one billion people only have the 'choice' of another hungry day (870 million in 2012, according to FAO- Food and Agriculture Organization of the United Nations, 2011). At the same time 30% of the food we produce is being wasted (FAO, 2011) and 36% of the calories in our food system are used to feed animals, not people (Cassidy, West, S, & Foley, 2013). This paradoxical situation may be related to the system. The change in '(food) sovereignty' may be one of the difference as compared with thirty or nine years ago.

This difference is best illustrated by looking at the global food system. According to Greenpeace (2015; see fig.1)[4] despite the 570 million farmers in the world, only six seed companies controlled 66 to 76% of the global seed in 2011. Between 2004-

3 Five professorates food & agriculture: Cyclical use of resources on the sustainability of production systems; Business models and personal leadership in the circular economy; Experience and Wellbeing, on the sustainability of consumption; Success and failure of social innovation and life style; Responsive learning for a reflective and innovative biobased society.
4 Greenpeace is an international independent action organization carrying out research itself by empirical local research measuring and cooperation with many independent scientists and renowned institutes or using data from the FAO or World Bank.

2008 three companies accounted for 72% of all patents and four companies controlled 99% of the global poultry production. Although there are 7.2 billion consumers, only four agricultural commodity traders control 75% of the global trade. Only ten food processing companies control 28% of the global market. Looking at Europe only ten grocery retailers own 30.7% of the market and in the 13 EU states fiveretailers own more than 60% of the market[5]. Do you wonder why you miss the local tastes when buying your food in the supermarket during your holiday abroad in contrast to the products you buy from the local bio-farmers at the local village market?

Although the reports focus on agriculture, sustainability and re-naturing, the difference is that all reports approach the ecological crisis increasingly from a more holistic system view covering as many relationships as possible instead of one sub-system. But where are the boundaries of the food global activity system. Where does it have shared objectives and outcomes with other activity systems.[6] The difference is that we are more and more aware that we cannot approach crises or problems in our society or personal life by analysing one solitary problem, but that we now realize we are living in one eco-system: the earth. And even the earth is a part of the eco-system: the universe as is illustrated, for example, by the relationship of the development of the nautilus shell to the lunar cycle.

Might it be that the crises described in the reports have links with other activity systems? So that we cannot speak of an agricultural or an environmental crisis as such? These problems may be much more interrelated with other problems. Although in the reports change of behaviour and decisions is an issue, it is not seen

as a cultural crisis yet. The advice in the reports, however, indicates a deep grounding in our culture, our behaviour and our way of thinking. Bowers (2015) indicates that the ecological crisis is also a cultural crisis, and notes that this is mostly denied. Also Sterling (2009) speaks in terms of denial. He concludes that the reason why education hardly responds to the challenges in relation to global and sustainable problems is the lack of explanation of the necessary changes needed in education to be responsive to it. He talks about 'education *for* change': the role of education to be responsive to it.
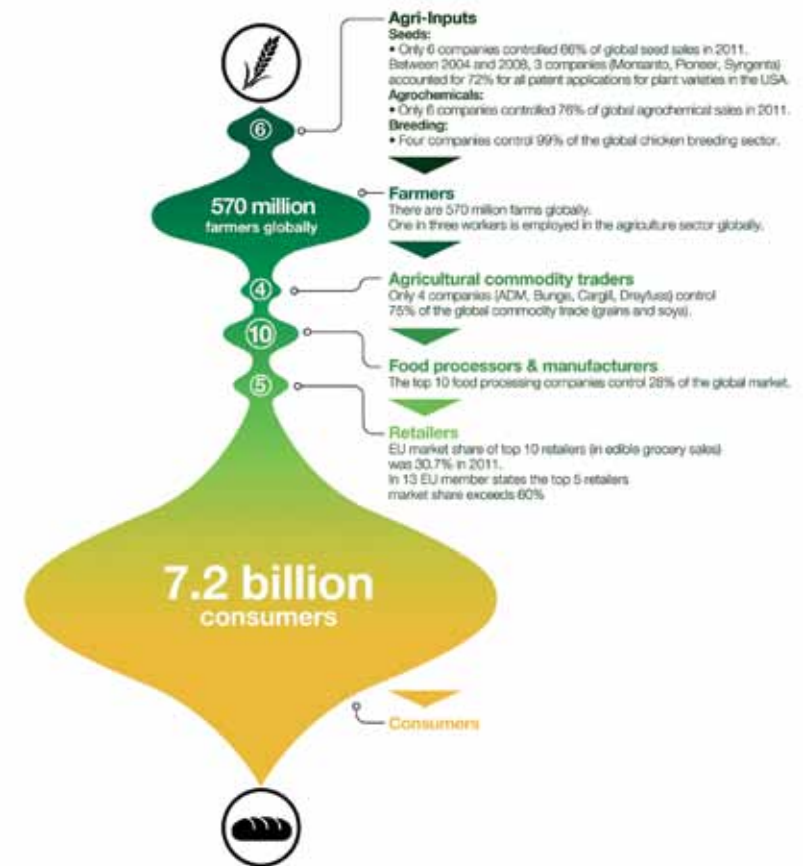
Figure 1: The global food system and a double bottleneck of corporate control between farmers and consumers, (Greenpeace, 2015).

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5 According to Greenpeace (2015):
   Top 10 processors | 1 Nestlé | 2 PepsiCo | 3 Kraft | 4 ABInBev | 5 ADM | 6 Coca-Cola | 7 Mars Inc. | 8 Unilever | 9 Tyson Foods | 10 Cargill
   Top 10 retailers in EU | 1 Schwarz Group (Lidl) | 2 Carrefour | 3 Tesco | 4 Edeka | 5 Aldi | 6 Rewe Group | 7 Auchan | 8 ITM (Intermarché) | 9 Leclerc | 10Ahold | Note that the top 5 retailers in the respective EU countries may be different from this list and it is, of course, not always the same top 5 in each country.
   Top 6 Seeds companies | 1 Monsanto | 2 DuPont | 3 Syngenta | 4 Vilmorin | 5 WinField | 6 KWS |
   Top 6 Agrochemical companies | 1 Syngenta | 2 Bayer | 3 BASF | 4 Dow| 5 Monsanto | 6 DuPont |
   Top 4 Breeding | 1 Aviagen International Group (part of EW Group) | 2 Cobb-Vantress (part of Tyson) | 3 Groupe Grimaud| 4 Hendrix Genetics B.V.
6 Cultural historical activity system (Engeström, Miettinen, & Punamäki, 1999)

education in supporting change in the person or society; and 'education *in* change': the policy changes made to educational rational, theory and practice that support 'education *for* change'.
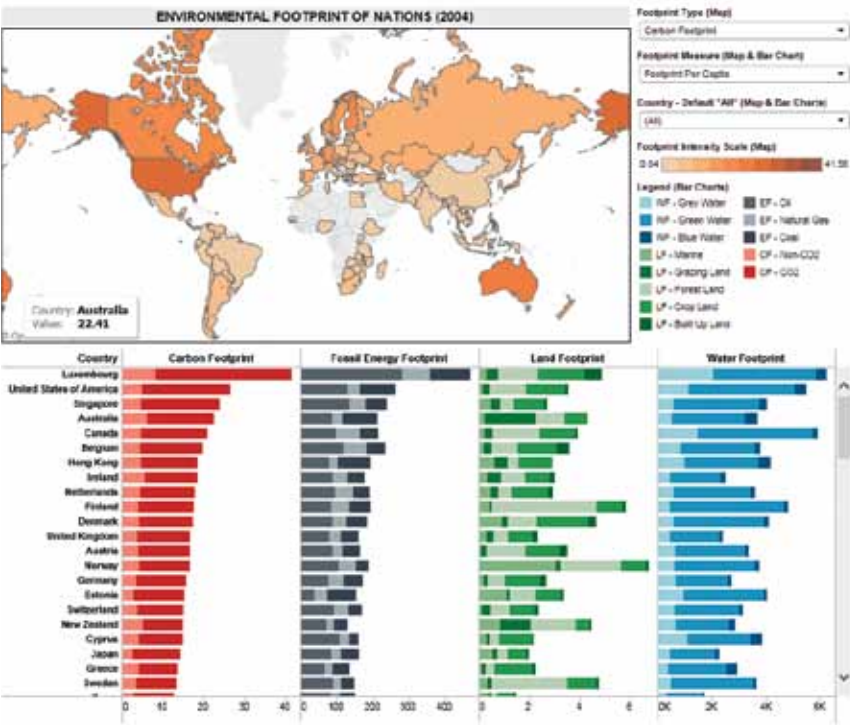
Figure 2: Data visualisations Environmental Footprint of Nations 2004. (Carbon Footprints of Nations, retrieved: August 2015, http://carbonfootprintofnations.com/ content/environmental_footprint_of_nations/). These pictures change if we look per resident or total nation development, in the latter case than China leading in the rang order.

The crisis is not locally or sub activity limited as we know already from the report of the Club of Rome in 1972 (Meadows & Meadows, 1972). Problems such as population growth, food production, industrialization, natural resource depletion, pollution, refugees, ethnical and religious conflicts and wars are globally related. Data visualisations strongly (see fig. 2 to 6) illustrate and indicate this relatedness. In figure 2 we see a high concentration of carbon pollution in Western industrialized countries

We can see an almost mirrored picture when we look at the population living in rural areas (fig. 3). Looking at the fragility in the world (see fig. 4), we see a lot of similarities between countries whose population, income, and employment are primarily in agriculture. Poverty may be an underlying factor, as 70 percent of the world's poor live in rural areas and for them agriculture is the main source of income and employment (fig 5). For this 70 percent depletion and degradation of land and water pose serious challenges for the production of food and other agricultural products to sustain livelihoods and meet the needs of urban populations (OECD, 2006).
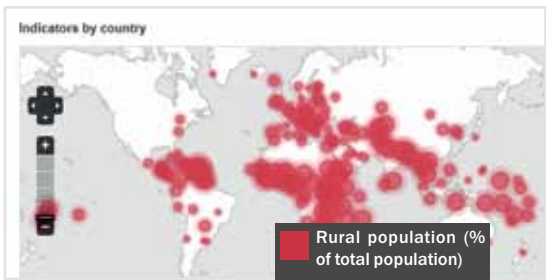
Figure 3: Percentage population in rural areas. (The World Bank, retrieved: August 2015, http://data.worldbank.org/topic/agriculture-and-rural-development). Data presented here include measures of agricultural inputs, outputs, and productivity compiled by the UN's Food and Agriculture Organization.
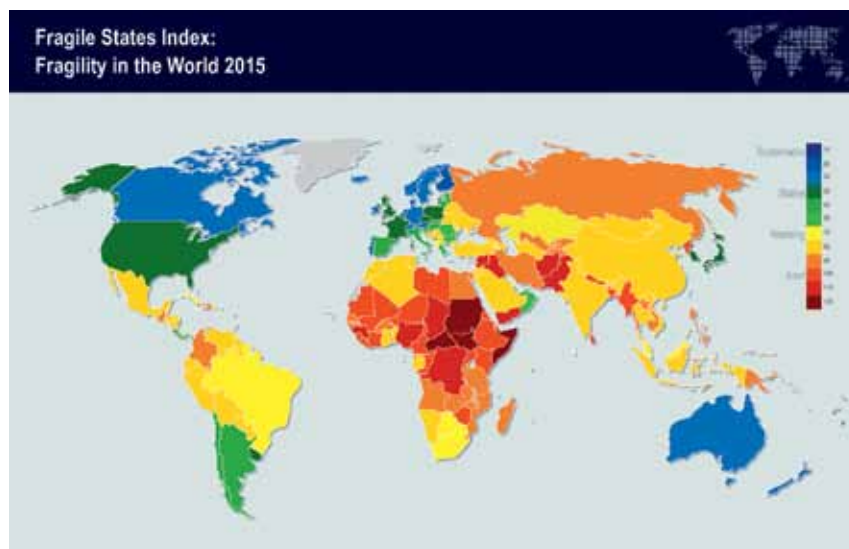
Figure 4: Fragile States Index 2015 (The Fund for Peace, retrieved: August 2015, http://fsi.fundforpeace.org/rankings-2015). The FSI focuses on the indicators of risk and is based on thousands of articles and reports that are processed by our CAST Software from electronically available sources.

Figure 5: The areas where people have to live on 2$ per day. (The World Bank, retrieved: October 2015, http://data.worldbank.org/indicator/SI.POV.DDAY/countries?display=map).

Figure 6: Internal displacement worldwide (Source: Bilak et al., 2015)

These data connections, analyses and visualizations show a relationship between a country's carbon output, mostly indicating industrial and wealthy countries in contrast to the African agricultural areas, the poverty gap and the countries with a high fragility. This takes into account the fact that at the end of 2014 59.5 million people were forcibly displaced worldwide (UNHCR, 2014) (see fig. 6), of whom were 19,5 million refugees[7]; 38 million displaced by conflict and violence (Bilak et al., 2015). This means that one person decides to flee every three seconds[8]. Conflict and violence are the main reasons for displacement, but how is this related to poverty, and how is it related to the low incomes in agriculture in these countries (fig. 5)? It is not difficult to understand that driven by daily worry (Sorge; Heidegger, 1977) and living on two dollars a day or less[9], many people take the risk of perishing while crossing country borders in the hope of finding work, food and a better future for their children.

7 http://www.unhcr.org.uk/about-us/key-facts-and-figures.html (retrieved 25 October 2015)
8 http://www.internal-displacement.org/global-overview (retrieved 25 October 2015)
9 https://blogs.worldbank.org/developmenttalk/international-poverty-line-has-just-been-raised-190-day-global-poverty-basically-unchanged-how-even (retrieved October 29, 2015)

What thought processes underlies the construction of walls and barbed wired fences in the belief that it will stop people leaving their home where conflicts, wars, economical and food for life condition are life threatening. What thought process underlies the belief that there is a logical distinction between asylum seekers (political, religious and war refugees) and economic refugees? It is what Rosling, a Swedish researcher who makes complex facts understandable in Factpods on YouTube [10], indicates that Europe does not have a humanitarian crisis because of the 'migration possibilities' of the many refugees. "Europe is part of the world" and "we as the world population have problems in this context: war" (Mulder, 2015).

Relatedness with our thinking and education

If we look at the 'wall building' behaviour, the perception of refugees as a common threat and enemy, what did we learn from the critical theory of the members of the Frankfurter Schule? Why are we so closed minded? Why don't we see relationships between the migration of people, conflicts, poverty, agriculture, etc.? The DAC Guidelines on Poverty Reduction, published in 2001, have already shown that poverty has multiple and interlinked causes and dimensions: economic, human, political, socio-cultural, protective/security (OECD, 2006). Reports such as 'Promoting pro-poor growth: agriculture' (OECD, 2006) and many others seem to make no difference. Building walls is a denial that the agricultural and environmental crisis is much more global and culture-related and therefore also education related.

A lot is known in and about our world and information is easy accessible on the internet, but perhaps we are not educated to see and think in relationships. At this point a better look is needed at the dominant role of education in how we learn to think. In many schoolbooks thinking in causality and directionality of effects is implicit, and even sometimes explicitly formulated. The logical analytical paradigm is dominant reflected in the teaching behaviour and conceptual thinking of students (Rossum & Hamer, 2010). This kind of thinking is also reflected in the globalisation process of where only a few corporations control the market, resulting in low sovereignty for farmers and consumers. This is not much different from the lack of sovereignty students have in what and how to learn and in short how

10 https://www.youtube.com/watch?v=YO0IRsfrPQ4 (retrieved October 29, 2015)

we think, and therefore the barely facilitated socially relevant learning.
Transition in the behaviour of consumers, politicians, donors, scientist and business as called for by Greenpeace, for example, means that people like you and me, managers, politicians, technical designers and not in the least educational actors have to start thinking in a different way. If I decide to separate my waste, buy food and products more eco-aware, or produce more food for life, it needs a different kind of thinking. It is a change of the state of mind or thought processes or how we have learned to think and our children are still taught at school. A fear of this change in our thinking is deeply rooted in our western history (Lakatos & Musgrave, 1978). Even to think that we can restore ecosystems may be a fiction as a product of our way of thinking. It is based on the assumption that our highly valued scientific method of hypothesis testing and prediction (evidenced based) will find solutions for everything. We expect too much from the positivistic way of doing science and way of thinking, although it contributes a great deal to our current way of life.

An example

Between 1805 and 1960 in the Netherlands three quarters of our nature disappeared as the result of human intervention due to the discovery of fertilizer and barbed wire. These discoveries were well intended - to produce more food by making it possible to cultivate rough land. Two thirds of the Netherlands is man-made farmland (Openlucht Museum exhibition Arnhem, 2015). Worldwide almost half of the earth's surface has been changed by human intervention into densely populated cities and intense agricultural use (Van de Gronden, 2015). The rest of the surface is dissected by roads, canals and other infrastructure. According to Van de Gronden (2015), there is hardly any real wilderness anymore. The impact of humans on the biosphere and atmosphere is comparable with geological forces such as a meteorite impact or volcanic eruptions. Nature untouched by humans may not even exist anymore ((Van de Gronden, 2015). So how can we re-nature? According to Van de Gronden (2015) we have to integrate in our thinking that nature is in a constant flux of evolutionary adaption to new circumstances and the same is true for humans. We have to learn to think in a way so that we make decisions with the awareness that acting as result of our thinking will impact all corners of our biosphere and the conditions of our common, global future, both physically and culturally.

Need for an ecological intelligent way of thinking

How can education as the womb from which we all learn how to think be responsive to this difficult dilemma or double bind (Bateson, 1972/1987) situation? Double bind because on the one hand we have to admit the western positivistic way of scientific thinking brings us a high level of prosperity and well-being, while on the other hand it brings with it a lot of very complex problems in the world. Take for instance the positive intention and first effect of the discovery of fertilizers, and the impoverishment of the soil due to the lack of natural fertilizer today or the dependency of poor farmers in developing countries on fertilizers. Our current way of thinking threatens human existence by the exhausting of natural resources and unbalanced dissemination of supply for the basic needs.

Are students being made aware of these double bind phenomena and are they being taught how to deal with them? During my regular visits to scientific educational conferences, I notice in the science teaching a lot of modelling and reconstruction of facts, 'objective' knowledge and data supported by simulations, even in cases where the research is about innovative educational settings such as peer dialogue in computer supported collaborate learning. It appears that in the teaching of teachers and teaching by teachers and professors the relational way of thinking is being neglected and in this sense the ecological crisis is a crisis in our thinking to which education has to respond in order to contribute to solving the crisis.

Teaching students to think in an ecological intelligent way, e.g. thinking in relationships and their nature, is vital to the development of ecological intelligence and thinking (Bowers, 2010). According to Bowers (2015) it is more thinking in the roots of Confucianism, Taoism and Buddhism with a focus on the awareness of the world of relationships and codes that guide these relationships. This is not ecological awareness in the sense of managing nature into which the Greek word oikos has been translated many times. It concerns understanding oikos in the Greek sense of interaction including the norms of many cultural practices. Oikos in the sphere of biosemiotics, how all aspects of the world work as a process of interpreting, meaning making and actions. This is the idea that life is based on semiosis, i.e., on signs and codes (Barbieri, 2008), understanding relationships not as cause-effect relationships, but as a process of messages, information, signs, codes of all kinds such as electrical, chemical, visual, genetic, temperature, radiation, cultural, e.g. me-

nomic, language, conceptions and ideas. It means understanding that thinking is interpreting information, codes and signs, information that inhibits or promotes adaptation, transition, responsiveness or change, codes that give rise to great novelties of macroevolution (Barbieri, 2008; Hoffmeyer, 2008).

This way of ecological intelligent thinking is the epistemic opposite of the paradigm that the autonomous individual (scientist) as a rational being can 'observe' objective information from the external world as is if it is about distinct objects. It is seeing the individual as a Dasein in the world (Heidegger, 1977), constructing meaning as part of and influenced by the relationships, e.g. the process of continuous communication and interpretation of signs and codes impacting on how we think, adapt, change and die out.

Reality cannot be understood without interacting with this reality (Naess, Christophersen, & Kvalø (1956) as cited in De Jong, De Beus, Richardson, & Ruijters, 2013). Entities and moments of insight are not propositions but actions (Tuinen, 2012). 'Connectedness' stands in contrast to a dualistic and deterministic separation between object and the knowing subject. It is thinking the relationship of theory and practice instead of separating it. It is complementary to (De Jong et al., 2013):

- the view that everything is knowable, that everything is caused by something
- reductionism of reality to quantities of what can be known, and
- the view of a calculated reality as the only knowable reality.

Ecological intelligent thinking is more a constructivist view that many educators and teachers refer to as a frame for their pedagogical acting, but actually generally do not realize. It is acknowledging that every situation is unique in relation to a previous one. It is like that every second step in the river never is the same as the first one as Heraclitus taught. Reality is always on the move and dividing it into stand-alone objects, facts, and propositions is artificial, a particular way of thinking. It seems congruent with what the quantum theory teaches us that parts (quanta) can be on different places at the same time or move in the same way at the same time and properties can only become visible by 'chance' when measured (Calmthout, 2015). But also this is not reality, it is the abstract human cognitive reality (Poppers's World 3; Magee, 1974). Reality seems to be more a dynamic, constant change of connections. Entities seem to be just temporary connections, expressions of reciprocal dependency (De Jong et al 2013).

Ecosystems are open (living) connections between elements. Reciprocal relationships are the essence of living systems, such as in the humanities. Interventions can have major consequences for a system (Engeström, 1987). It is therefore important to know in which system you are intervening. You have to zoom in and out in order to oversee the whole. To predict the expected effects as an impact of the responsiveness to meaningful differences manifesting themselves in the interactions is an important characteristic of connectedness and of ETI-based research.

Understanding complex reality goes beyond knowing and understanding stand-alone entities, by interpreting the relationships, the connectedness of the different entities, and their reciprocal dependencies. Thinking in relationships enriches the paradigm of giving meaning, naming, and describing entities (Libbrecht, 1995). In terms of Bateson, (1987; Montuori & Montuori, 2005) creating meaning is the basis of the difference between entities that makes the difference and corresponding actions that lead, for example, to transition. Relationships, especially in the humanities, can have a qualitative value, and intuition and imagination as a way of thinking and learning (Ruiters, 2011) come to play a role in interpreting them. In the drive to understand, questions arise regarding what 'is', what the connection means, and what makes up reality in all its complexity?

Ecological intelligent thinking presumes that humans are active beings in an interactive relation to their environment; acting towards objects and other species on the basis of the meanings they ascribe to those objects and species on the basis of the signal interpretations in the interaction with them. Meaning arises out of social interactions with others and society, as the result of interpretative processes by a person while dealing with their environment including nature. In a sense, this connects to the basic three premise of symbolic interactionism (Blumer, 1994) and three additional premises which clarify and extend Blumer's position by Charmaz and Snow as cited by Charmaz (2014):

1. "Humans act toward things on the basis of the meanings they ascribe to those things."
   - Meanings are interpreted through shared language and communication (Charmaz, 1980), p25.
2. "The meaning of such things is derived from, or arises out of, the social interaction that one has with others and the society."

- The mediation of meaning in social interaction is distinguished by a continually emerging processual nature (Charmaz, 1980), p25.
3. "These meanings are handled in, and modified through, an interpretative process used by the person in dealing with the things he/she encounters."
   - The interpretive process becomes explicit when people's meanings and /or actions become problematic or their situations change (Charmaz, 1980; (Snow, 2002).

Ecological intelligent thinking relates even more to what Bateson indicates in his book 'Steps to an ecology of mind' with 'the differences that makes the difference' (Bateson, 1987, p.276). Seeing relationships as the ecologies of differences that lead to reciprocal response, e.g. consolidation and change. How often do we ask ourselves and our students to inquire what the difference is, in the information, to what an animal, a person, an organization, a substance responds and by doing so impacting his or its behaviour or appearance e.g. it's being. These differences, information, are not attributes of a subject or object, but are the relationships. It is the space indicated by Ruijters, (2015) by citing Frankl (1905-1997): 'Between stimulus and response there is a space. In that space is our power to choose our response. In our response lies our growth (..).'

In current science and education, the main focus concerns the descriptions and determinations of attributes of the subject/object of study, correlational or causal explanations and predictions. In ecological intelligent thinking understanding relationships goes beyond such a focus by understanding the reciprocal process to the other (subjects and objects). In that sense we can say that the humanistic idea of the self as a kind of autonomous entity is a fiction. You will only find 'yourself and your unicity in the reciprocal process to others (humans, animals, plants, objects) in getting to know your ecosystem, the differences in the relational processes. According to Hoffmeyer (2008) an expert in biosemiotics, human individuality and unicity is not justified by its particular genetic combination, but by its uniqueness as a particular semiotic creature.

Back to education

So coming back to education, according to Bateson we need not only the world of the conceptual artefacts, the public community knowledge, such as theories, ideas, sculpture art, dance, music, traditions and scientific concepts, but also the process. As in scientific research, you start from two beginnings instead of one. Each of which has its own kind of authority: the observations cannot be denied, and the fundamentals must fit. Bateson illustrates the scientific thinking process as follows (Bateson, p6): *"If you are surveying a piece of land, or mapping the stars, you have [remark: to start from] two bodies of knowledge, neither of which can be ignored. There are your own empirical measurements on the one hand and there is Euclidean geometry on the other. If these two cannot be made to fit together, then either the data are wrong or you have argued wrongly from them or you have made a major discovery leading to a revision of the whole of geometry"*. Actually we see here a process of knowledge creation, which could be a starting point for responsive education. In the knowledge creation process (De Jong, 2006) you start from your own idea (theory). You then look whether it fits with what can be observed in practice and what is known in scientific or practical theories. You need to enter into dialogue with others in order to reach a better collective understanding of the phenomenon by listening and exploring someone else's idea. Empathically willing to understand them and contributing to them and rising above when finding the difference that has potential for the future, our world and handling in the own ecology. Building up the rise above leading to a shareable conceptual artefact on which others can build on again in their turn. That is why my current research project on knowledge creation and ecological thinking connects to the project starting up knowledge related to transitional thinking in agricultural sector and how education can be responsive to it and what kind of learning is needed to develop ecological thinking of students. The following is relevant in this context.

A theory or study book is not reality

It is good to realize that all the pictures and text above are not the 'earthy' reality as is René Margritte's painting is not a pipe (fig. 7). They are the flickering shadows projected on the wall of the external reality which they are only able to see by the people living in Platos cave. It is therefore important that scientists and students recognize that the words and language used have a history and a cultural back-

Figure 7: 'Ceci n'est pas une pipe'. Margritte's painting of a pipe. (foto Shutterstock)

ground. So by using theories, students use the thinking and the way of looking at the world of previous era as is stored in the language. Approaching data or phenomena from different perspectives is limited because we educate students in a particular language of a discipline or domain by modelling them in the thinking of that discipline or domain. Jargon and abbreviations in that sense are not only a reflection of implicit, informal knowledge, but also a way of thinking and communicating in a particular community. Although students feel they get more grip on reality, they actually are more estranged from earthy reality. I think this is what Bateson calls 'the map is not the territory'. Theories, study books, art, e.g. conceptual artefacts, are a man-made reality linked to the earthy reality in the same way that the nautilus shell is linked to the lunar cycle. A theory is not the earthy reality. This you can experience when, for instance, students return from internship saying 'in practice everything is different'. Or when rebuilding your house where the architect drawing as an artefact of ideas of the new house is certainly not the reality. Construction workers interact daily in this reality. Seeking the difference of thinking of the architect, and interpreting the difference in the language of the previous construction workers as is crystalized in the current building. This reciprocal process of communication and the way the current construction workers act on it creates the new reality of the rebuild house.

The same is true for textbooks, theories, standard curricula and whatever students learn at school. They don't learn the real reality. They learn conceptual artefacts enclosing old ways of thinking e.g. looking at the relationships in the world for instance as cause-effect explanations and predictions. It is the constructivism tenet that draws our attention to the perspective that "reality construction is the product of meaning making shaped by traditions and by the culture's toolkit of ways of thought" (Bruner, 1996).

As such nothing is wrong with this. But it sets transition and education in a double bind situation. This double bind situation where we teach well-intentioned ideas and agendas which brings prosperity, but also ideas that actually contribute the problems rather than actually overcoming the current social and ecological problems. We cannot fix problems by relying upon the same mind-set that created it (Einstein quoted by Bowers, 2015). Gadamer (1975) already taught us that the understanding of events is always influenced by the previous experiences that are already available. There is no understanding which is free of our previous experience and no method can free readers and writers of these previous experiences. This is particularly true in terms of method and evaluation noted preconception affects what is heard and read. The method is the look by which you want to see the world. The 'truth' is the experience. We have to be aware that there is not one 'truth', we must be aware that "after us, others always will understand different". (Gadamer, 1975, p 355)[11]. History is not a fixed truth, but a process of ideas and changing of ideas. It is the process where the truth goes beyond the subject's knowledge, you can feel the truth but you can't denote, tell or describe it. This makes the truth, that understanding is language. Language is relative[12] and so are theories in relation to the world of practice. Being aware, and being taught this awareness, is essential to progress in our understanding, in seeing which difference makes the difference, which makes transition.

'Understanding the difference' might be a way to follow

Nowadays students of all ages have experiences on the internet going beyond the boundaries of their own personal perspectives, time and space. They are used to viewing a particular phenomenon from different perspectives in the avalanche of information search machines give you when you enter a keyword. When they come to school, they are generally restricted to one information method, mainly a mechanistic view of looking at life which is actually much more an organic process; and standard tests. What they often miss is an education in which they learn from the differences of all this variation of perspectives and information. To build knowledge from it. Not by learning by heart and being drilled in the reproduction of different models, theories, etc. and taking them for granted, but learning to understand these models and theories by entering into dialogue and discovering what makes the difference between them and the fit with their reality. Discovering how old 'language meanings', e.g. way of looking at the world in previous times, are implicit to it and where the potential is for the future. Education means looking to the relationships in the sense of what makes difference makes students unique as a individual semiotic creatures. Unique in the way he as a person creates meaning by researching that the theory is not the practice and learning from the different perspectives, from the variations of the double bind situations, and building new ideas to overcome complex problems of current life. This all gives thoughts and a basis for looking at learning and the educational process from a different perspective. This is reason enough for me to reinterpret the different manifestations of learning and to examine them in the light of such interaction and Bateson's (1972) 'a difference which makes a difference'. The latter is a second reason for reinterpreting learning in the next part to better understand Bateson's statement in the context of transition and responsive education.

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11 *"Es liegt in der geschichtlichen Endlichkeit unsers Daseins, das wir uns dessen bewust sind, das nach uns andere immer anders verstehen werden"* (Gadamer, 1975, p 355).
12 Sapir-Whorf hypothesis (the hypothesis of linguistic relativity) states that the specific language we speak affects the way we think about reality.

Part 2
Learning reinterpreted

I'm educated as an experimental and learning psychologist and lecture learning psychology courses up to the present day. While preparing lectures, I always have an unsettled feeling about the linear character of most learning theories. I notice that the intervention and stimulus-response reinforcement of behaviouristic learning experiments may be the basis of this. In addition to Piaget only a few numbers of studies I got to know in the '70-80' used observation as a method to understand learning (Deese & Hulse, 1967). Although my own study on self-regulated learning was based on analysing a few hundred thinking-aloud protocols (De Jong, 1992), I kept thinking and looking to learning as a linear process going from orientation-planning-monitoring-testing toward the learning goal. I was a child of my education and the '70, '80-ties by reading about metacognition and self-regulation and the student as a goal direct good strategy user (Brown, 1978; Flavell, 1979; Flavell & Resnick, 1976; Pressley, Borkwski, & Schneider, 1989). Despite the fact that research on self regulation has become much more observational and questionnaire based (De Jong, 1992; Veenman, Van Hout-Wolters, & Afflerbach, 2006; Vermunt, 1992), learning is still mainly seen as a linear process. Concordance analysis was my first attempt to break away from this perception (De Jong, 1992). In the post-hoc analysis (De Jong, Kollöffel, Van Der Meijden, Staarman, & Janssen, 2005) we discovered that the self-regulation processes were less linear in nature. All processes such as orienting, planning, monitoring, directing learning activities, testing and evaluation took place during the whole time that students are learning (see fig 8). Some processes are more frequently used in the beginning, the middle or the end phase of a learning task, but still every process is used when needed at whatever moment in a learning task.

From the beginning of my research on self-regulation it was clear that student learning was not an isolated activity. Learning depends on the context of the learning task, the subject and his metacognitive knowledge of his own learning behaviour. Students told me for instance *"I'm very good at solving mathematical problems, but I don't know how to learn English idiom"*. During that period, I interpreted it as a personal factor in the sense that some students have more talent in particular disciplines such as mathematics or language.
Nowadays I would interpret it more in terms of interactions with their ecology. Friction in their communication process in which they don't understand the feedback signs about the effectiveness of their learning activities in a particular discipline or
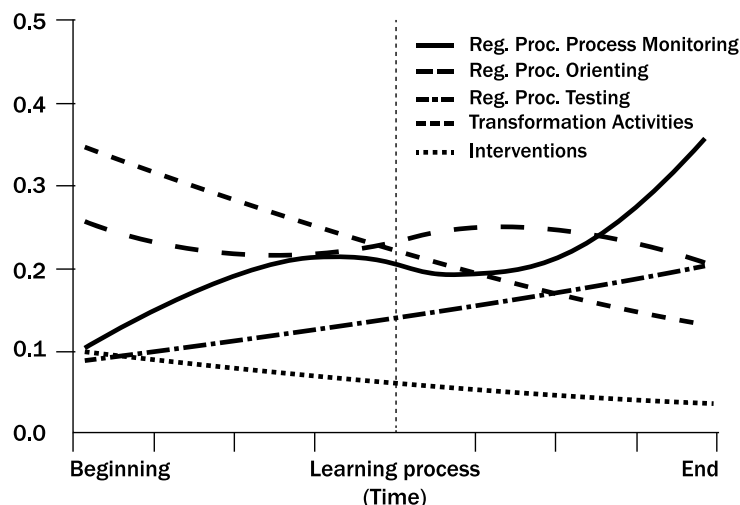
Figure 8: Probability curves for different regulative processes, transformation
activities, and external interventions (De Jong et al., 2005)

learning task environment. They have problems interpreting the signals and choos-
ing other learning activities that might be more effective. Their idea of how to learn
a particular learning task doesn't fit with their reality. Fixed in the way they think how
to study a learning task, they keep doing the same. They are not able to or find it
difficult to discover what difference it makes using other learning activities that
might be more effective. Is this perhaps related to 'the map is not the territory' and
the absence of starting with 'two-beginnings'? The latter because they know, meta-
cognitively, not being successful in the way they think they have to study the task,
but are not checking if this is coherent with the practice. For instance, they don't
ask successful students how they study the task and while studying how they know
they will be successful.

This makes me curious if a *'reciprocal interpretation process' (the student as a se-
miotic creature)* is an aspect which can help me find differences in learning as it
manifests itself in the learning science in the context of its potency for transition.
Placing the concept of biosemiotic into the human ecology we can speak here in a
more broader sense of the sign relations to culture and can speak of the *eco-semiotic*

dimension of learning e.g. making meaning out of the sign relations established by
culture (education, training, upbringing, friends, peers, disciplines, school), which
deals with other living beings, communities and landscapes (Nöth, 1998, 2001).

Learning makes use of 'language' and therefore learning is culturally loaded. The
process of learning is not only related to an individual, but also to his culture, com-
munities, in brief: to others (De Jong, 2006) directly in his/her environment. So a
second aspect that might help to find the difference in how learning manifest itself,
is to look at what extent *'others'* are explicitly involved in the process of learning.

Others means not only the people you work with or learn with, but also artefacts
where a learner encounters others (authors, scientists, journalists, writers) when
reading a theory, a book, an article, or watching a documentary. This might be a
third aspect that can help me: To what extent is there a sense of 'historical aware-
ness', the awareness for *'thinking the past'* explicitly in the learning? This is in line
with Bateson's statement "the map is not the territory".

A final aspect of learning that may help me here relates to what extent the know-
ledge or the learning expresses a reproduction of isolated facts in a single frame
of reference in contrast to more contextual, relativity of one truth. This may even be
knowledge as result of ordering, exploring, synthesis, recognizing and discriminat-
ing complex patterns of interpretation. This is actually the implicit or explicit *epis-
temic development* of a learner.

Problems arise when tools developed in the service of one epistemology, say cog-
nitive information processing, are integrated within instructional systems designed
to promote learning goals inconsistent with it (Bonk & Cunningham, 1995). This is
because the tools embed beliefs about learning and teaching. Rossum & Hamer
(2010) are talking in this context from an *epistemological ecology.* They indicate
that the development of a student's epistemological development is not caused by
one source, but by conception in a person's (educational) environment. In the edu-
cational context this includes, according to Rossum and Hamer, the beliefs in the
teaching practice or teachers' epistemological perspective, the culture of the edu-
cational institute, the image of the discipline, the assessment practice, the stu-
dent's self concept, motivation, study strategies, etc. The whole has to be coherent

in order to stimulate students to go beyond reproductive conceptions to reconstructive conceptions in building knowledge. Not only are there many ways to stimulate epistemic development, but also "choosing to change only one aspect may not be sufficient to dramatically change the balance within an ecology" (Rossum & Hamer, 2010, p. 230). So a fourth aspect that may help me to differentiate how learning manifest itself is *epistemological development* as a consequence of an epistemological ecology. I like to expand ecological environment to Popper's idea of knowledge worlds (Bereiter, 1994, 2002; De Jong, 2006; Magee, 1974) in order not to fixate on the school environment, but more on the whole, i.e. the epistemic ecology of World 1 the physical world, the beliefs that are embedded in the world of doing and material entities, the practice. The epistemic ecology of World 2 of the cognitions of subjects' minds, the world of school learning. And the epistemic ecology of World 3 the conceptual artefacts, of collective understanding (Verstehen, (Gadamer, 1975), the objective knowledge, understandings that can be grasped and built on.

Because this writing is related to several projects of transition thinking and transition in the agricultural and food sector, I need to reflect on the outcomes of the four aspects in the light of their potential for transition thinking, which will be the fifth aspect although this is not an aspect of the learning itself. So the following aspects will guide me in reinterpreting learning.

1. Eco-semiotics: *reciprocal interpretation process*
2. Others
3. Thinking the past
4. Epistemological development
5. Transition potential

People like levels, taxonomies for ordering or giving value. The last aspect might be one to make such an order. However, I prefer not to speak of levels yet. Just because of my idea that we probably need all, or that we are involved in all kinds of learning in order to survive in life and that life survives. So even if there is a suggestion of an order, in my belief there is not, although the reinterpreting is guided along Bateson's four levels of learning. I want to see how learning manifests itself, and that is why I speak of manifests of learning.

Manifests of zero learning, natural learning

Let's start with what Bateson (1987) calls the Natural, zero learning: *Habituation*. Habituation is perhaps the simplest form of learning. It refers to a decline in the tendency to respond to a stimulus once it has become familiar. So when I shout HEY loudly in my lectures, students are stimulated and react in a frightened manner, thinking something is happening. But actually, nothing is happening. The shouting alarms them. When I shout HEY loudly again a second time, students react not at all or are less frightened this time, because they have learned it is a false alarm. Psychology textbooks (Gleitman, Fridulund, & Reisberg, 1998) tell me that this kind of learning plainly relies on memory. A person or organism remembers his previous experiences. Hearing me shouting HEY the second time, the students must somehow compare what they hear and see the second time with what they heard and saw the first time.

The opposite of habituation is **sensitization**. So if something actually happened the first time, students will react even more intensively the second time. These learning phenomena have a biological basis in the Long-term potentiation (LTP), e.g. strengthening the synaptic connection by repeated stimulation so that postsynaptic neurons are more easily activated. According to Gazzaniga & Heatherton (2003), the LPT is close to the behavioural conditioning because of the nearly identical neurochemical effects that are produced.[13] In sensitization, there are more pre-synaptic neurotransmitters, and the neuron itself is more excitable. In habituation fewer neurotransmitters are released at the synapse each time a 'false' stimulus is detected (Boundless, 2015). You could say that it is a kind of **reflexive learning** characterized by specificity of response, which – rightly or wrongly – is not subject to a conscious, but a subconscious correction. Also **cumulative** or **mechanical** learning as an isolated formation, automation (Illeris, 2009a) belongs to this zero category of learning. Although Illeris (2009) put this in the context of conditioning in the behaviourist theory, I agree with Bateson (1987) that this is more a kind of zero-learning. As with the LPT, this is a neurological trace in my mind resulting from a manifest of learning described in the next paragraph: learning I. Zero learning is maybe the learning involved in 'evolution'. This is the basis of how species adapt and change themselves to the environment, and why there are so many cies adapt and change themselves to the environment, and why there are so many

13 I notice here that study books are not neutral, reflecting what is known in World 3, but often you read in these study books that interpretations by the authors of the World 3 are conceptual artefacts.

different variations of one species. An example of this is the fact that Galapagos turtles are different on each of the islands due to the different signs in their ecology.

Reinterpreting

Looking from an *ecosemiotic, ecology-as-relation perspective* I can see the linear, causal 'stimulus-response' differently. At the heart of this process, for behaviourists the black box, an organism interprets signs from the environment, and chooses to lower or rise the alert. In the previously mentioned comparison between now and the past, the sign 'HEY' is information received from the outside world. The alertness reaction is a selection of an adequate behaviour in my repertoire that takes place in a kind of semi awareness, automated way. Let's try another example. Sitting in your car on your way home at 0:30 am you know that on a particular traffic intersection a vehicle never comes from the right side. When you see the orange flashing lights, you take your foot a bit off the accelerator pedal or maybe not at all. If something moves into your peripheral vision, another signal, you become fully aware and change your response and hit the brake, which action is generally too late. This does not mean that you receive the signal too late or have trouble interpreting it. The automatism, semi awareness situation of the habituation, mainly has an effect in directing your physical motor system. This is why you don't start braking soon enough, your motor reaction is slowed down by your learned habit or call it foreknowledge, learning that is compiled in your locomotion (De Jong & Sanders, 1986).

So what we see here, is the flashing traffic light and the peripheral movement are both signs from which you interpret the locomotion of your foot, lifting it off or putting it on the brake pedal. According to Bateson (1987) these actions to signs may be regarded as an answer to a question laid down in your mind by previous learning of a second order (learning I), but the single event of receiving this piece of information is a piece of learning. The latter is demonstrated by the fact that having received the signs, you changed and respond in a special way to the traffic light or peripheral movement in a more habituating or sensitizing way.

We see here an ecosemiotic process of interpreting environmental signs, although not fully aware between the implicitly learned idea (there is almost no traffic coming from the right) and reality (there is something coming from the right direction this time). The signs are interpreted in a kind of compiled knowledge relations which en-

ables you to respond quickly without long cognitive processing. Because of this compiled relation between the individual and his environment, the interpretation is fairly automatized.

'Thinking the past' here concerns the memory trace that is built during action on a factual level.
'Others' are not involved in the interpretation or are involved very passively as a sign in the environment.

The *epistemic ecological process* characterizes itself as the factual process of consequences. The difference that makes a change, concerns the information if the idea in my mind is still consistent with the actual situation, the praxis. If this is not the case, then it will lead directly to a different action, but not always to a different idea. And if so it can decline, regress to the previous idea and habit if the incident, a person coming from the right, was accidental. This change, regression to previous habit, is not a proposition of the shouting or the person coming from the right. It is the difference in the relation of my shouting signal and context on the one hand and the response of alertness on the other hand, and how shouting and action is compiled in this habit on the basis of previous experiences. So it is also not a proposition of a person's memory as such.

From a *transition perspective*, this kind of learning is probably what we are doing during the day. Habits might therefore have an evolutionary pace of change.

Manifests of Learning 1: biological and consequences

The second category of learning concerns the learning by conditioning like in Pavlov's **classical conditioning** and Skinner's **operant conditioning**. In general, this is understood by learning theorists as the formation and strengthening of associations or weakening of existing associations. So learning is seen as building associational relations like we associate, for instance, sun with light and warmth, thunder with lighting and a smile with friendliness (Gleitman et al., 1998). In the Classical or Pavlovian conditioning living organism, so also people learn to respond to the conditioned stimulus (for instance a buzzer, previously a neutral stimulus) with behaviour (salivation of a dog, previously an unconditioned response) which was formerly

evoked only by an unconditioned stimulus (for instance meat or other food). By pairing the neutral stimulus (the bell) with the unconditioned stimulus (the meat), the bell becomes associated with the meat and becomes a conditioned stimulus. This conditioned stimulus (bell) always precedes the conditioned response (salivation). In daily terms: I see that it is noon and I'm getting hungry.

In Classical, natural, conditioning the reinforcement does not depend upon the subject's behaviour. The behaviour was always there; it just becomes associated. In the Instrumental or operant conditioning, the reinforcement depends on the subject's behaviour. If there is a stimulus and a subject behaves in a particular way, reinforcement takes place.

The unconditioned stimulus in operant conditioning is usually vague, e.g. the whole sum of circumstances in which one is put, for instance a problem-box and hunger. The reinforcement can be a reward, withdrawal of a punishment, or avoidance of a negative context. Rewarding takes place if there is a desired or a by others preselected behaviour within the behavioural repertoire of the subject. For instance, I see a red traffic light, slow down the speed of the car and stop (avoidance of a ticket or accident). So in the operational conditioning we see learning from the consequence of behaviour. This is the famous Thorndike's law of effect: any behaviour that is followed by pleasant consequences is likely to be repeated, and any behaviour followed by unpleasant consequences is likely to be stopped. It forms the basis for learning new habits. The action is stamped in the mind. There even seems to be a biological basis in the form of intracranial self-stimulation, the so-called 'pleasure centre' in the brain. The more the centre is stimulated by a particular behaviour, the more likely it is that this behaviour will be repeated (Olds & Milner, 1954).

Any free will or any internal motive is caused by some consequence of behaviour in the past, e.g. the personal history and genetics according to Skinner, the godfather of operant conditioning.[14] So motives, 'free choices', thinking are learned from experiencing the consequences of external factors. A famous utterance of Skinner is: 'thinking is behaviour'.

14 https://youtu.be/I_ctJqjlrHA?t=175 (Retrieved October 2015)

Reinterpreting

Thorndike, Skinner and others who believe learning is a consequence of behaviour don't see learning as a *conscious ecosemiotic cognitive process*, but as a trial and error process. However, looking at learning curves you can see that when a subject learns to recognize patterns by learning to receive signals in a series of similar learning experiments, a change in the rate of prototype learning can be observed. In each successive experiment a person has a steeper pattern recognition learning gradient (e.g. **prototype learning or rote learning**). An other example where subjects not only learn from behavioural consequence is Tolman's experiment in which rats have to find their way through a maze to reach a goal box containing a reinforcement. In these experiments a phenomenon occurs that Tolman called '**latent learning**' (Tolman & Gleitman, 1949; Tolman & Honzik, 1930). Rats learned a cognitive map, although they did not receive a reinforcement (fig. 9).
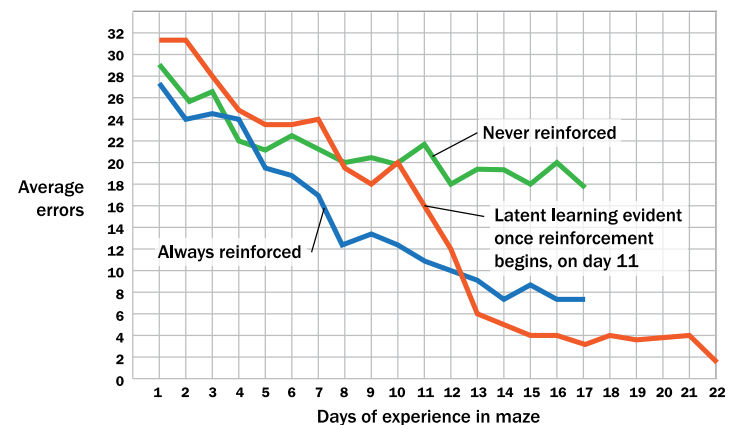
Figure 9: Latent learning Tolman (CHSAPPsych, https://chsappsych.wikispaces.com/ Tolman,+Edward.retrieved: October 2015.

This gives me ground to think that the classical and operant condition, despite the reinforcement, is also a matter of interpreting the environmental signs which are received and the differences between these signs which express consequences of my responses to signs. But it is not only the consequence that plays a role. I think that the mind-set does as well. Skinner not only controlled the consequence: rein-

forcement or non reinforcement. He also tried influencing the mind-set of animals by depriving them of food until 3/4 of their normal weight is reached. These animals had a biological hungry state of mind. Their mind was implicitly set to interpret environmental signs and the difference between them in a sense that had the greatest potential to change the state of hunger.

The latent learning phenomenon shows that if we can't interpret a difference in relation to solve the state of hunger because no food is provided as a reward, signs are still interpreted in relation to the mind-set of 'finding your way in a territory'. Although there was no reinforcement, they still learned. So actually what we see here proved is the modern statement 'learning takes place anywhere anytime'. The latent learning sometimes even results in a sudden insight, or solution you reached after a period of inaction or contemplation of a situation. This is something I frequently experience while writing this publication.

Looking back at the pigeon learning experiments I had to carry out as a psychology student, many of these pigeons did not show the Skinner results. I wonder now if they had not enough food deprivation, although we had checked this. Or did the pigeons make another choice in responding to the environmental signs, for instance the attention we paid to them as students. Maybe they did not perceive the difference between attention and food.

What happens if the animals Skinner used in his experiments had more choices? Such as, for example in Harlow's (1962) experiment with rhesus monkeys that had the choice between a bare wire mother monkey with a milk bottle and another soft terry-clothed wired mother without a milk bottle. The infant rhesus monkeys choose the warmth, softness and comfort of the clothed mother, but when they were hungry took milk from the bare wire mother while still clinging to the terry-clothed comfort mother.

I definitely see an ecosemiotic process in this Learning 1. Learning 1 can be distinguished from Zero learning in the sense that 'others' set the goals by controlling the environment for the consequences, e.g. that is the choices that can be made, but also influencing the mind-set like we see in the food deprivation in the operant condition experiments.

In education and work it is a daily practice to influence a mind-set and preselect choices e.g. consequence. For instance, we aim that our students 'develop their talents' or 'are able to self-regulate' and at the same time they have to succeed in the core curriculum. Learning to self-regulate is learning to learn to receive signs from the environment to correct behaviour, in this case the study behaviour. So actually to develop: 1) a higher ecological awareness for the meaning in the signs to become a successful learner as a predefined talent. 2) correcting my actions based on feedback signs coming from the environment by seeing and understanding the differences e.g. understanding what helps me the most in what I have to become according to others: talented. In the transfer to other contexts we need the same kind of openness for receiving context signs and correct actions in order to succeed. "Context" as a collective term for all these events which 'tell' the organism from which set of alternatives he must make his next choice (Bateson, 1987).

Thinking of the past is not explicitly focused but implicitly activated by the external influenced mind-set and in the choices that are offered, so actually in the behaviour that is learned. What is wrong, for instance, with the fact that I'm not always self-regulated and that I need the help of others? Is this a western humanistic value, way of thinking? It goes beyond the scope of this document to go into this here, but reading Biesta (2006) is a good suggestion.

Students develop an *epistemology* an 'if-then' knowledge idea. The 'mind-set–stimulus- action-consequence' is the central relational way of thinking in this kind of learning. There is a *low or no understanding of the implicit settings by others or culture.* There is no awareness that old ways of thinking and values are nestled in the learned behaviour (mind-sets).

The fact that every student is happy when he or she receives a high grade in an examination is this a natural or learned feeling reinforced by the compliments, rewards of your parents, teachers, peers every time you succeeded in learning something?

From the *viewpoint of transition* people in daily life make many decisions and behave based on the immediate, short term consequence. In contrast to the Zero learning, change in Learning 1 is less evolutionary, so that gives a better prospective. To manipulate Learning 1, changing learned behaviour, we must become

aware which pre-settings, values, biology and mind-sets are explicitly and implicitly active in our learned behaviour and attitudes. We also have to get to know what choices are possible and how the consequences can be experienced in the short and long term. And if consequences change, behaviour will stop or change.

Manifests Learning 2: new elements

This learning concerns how sequences of experiences are built up in our mind and what we do when reality is different from the ideas we have built from our experiences. Concepts developed by Piaget belong to Learning 2 and relate to changes in the process of learning such as assimilation and accommodation. Don't worry I will explain those two terms. It concerns the change in the set of alternatives from which choices are made. According to Bateson (1987) the patterns of thought of the individuals are so standardized that their behaviour appears to them logical. Fields and categories are already defined in your mind. If you come across new information which fits into those fields, your thinking can **assimilate** it easily. For Illeris (2009b) assimilation means adding new elements to an existing scheme or pattern in your mind. What you perceive in the outside world is incorporated into the internal world, without changing the structure of this internal world. It may be that the experiences or observations are simplified, distorted by the cognitive abstraction in order to fit in the existing scheme or pattern (see fig 10).

Outside   Inside your head   Outside

**Assimilation:
fit practice to theory**
Complex but familiar external objects are simplified
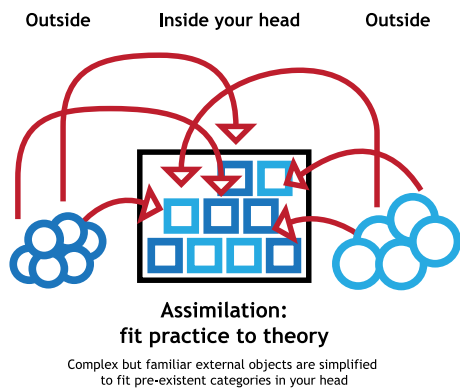to fit pre-existent categories in your head

Figure 10: Assimilation: fit practice or theory. Complex but familiar external objects are simplified to fit pre-existent categories in your head.

There are situations, new experiences which are not immediately related or do not fit into an existing scheme or pattern of thinking. In this case **accommodative or transcendent learning** can occur when the internal world has to accommodate itself because evidence does not fit in your ideas or theories. So parts or elements of existing schemes or thinking patterns have to break down and have to be rebuilt to accommodate the new information (see fig. 11).
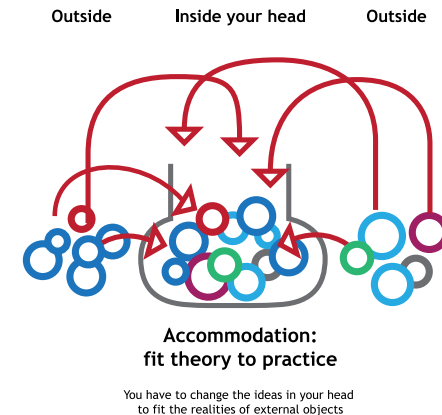

Outside   Inside your head   Outside

**Accommodation:
fit theory to practice**
You have to change the ideas in your head
to fit the realities of external objects

Figure 11: Accommodation: fit theory to practice. You have to change the ideas in your head to fit the realities of external objects.

Reinterpreting

It is obvious that *assimilation and accommodation is an ecosemiotic process.* Information from the outside world leads to cognitive construction (Von Glaserfeld, 1974). The interaction between the information and the internal mental world is a constructive action of meaning making by a person which goes two directions. One, in the case of assimilation, the direction goes into verification, increasing knowledge by reproductive understanding. Schemes are getting bigger and bigger. The other, in the case of accommodation, the direction is into understanding the subject, the phenomena, widening the personal horizon. In both situation there are two beginnings: existing internal schemata and the practical information one is confronted with. So actually this learning deals with 'the map is not the territory'. In *accommodation it has deeper consequence on the epistemic level because of the*

stronger reciprocal constructive interaction. Concerning *assimilation the information is shaped into reproductive knowledge.* There is no real change of knowledge insights or understanding. In the accommodative learning new insights and understanding are generated, but still in the same process of thinking. There is no transcending of the way one thinks, but a transcending of the constructed schemas into accommodated ones. So one accommodates the knowledge in existing frames of thinking. It is not the way of thinking that is in play, but the new information. So *'past thinking' stays mostly intact.*

These semiotic processes are on the level of the individual's mind. Their internal knowledge insights are more or less shaking, as it were. *The 'other' is still at distance as a source of information.* Widening the horizon may affect the transfer of understandings from one domain to another into the schemas and patterns of the own domain.

Epistemologically one constructs cognitions (thoughts, opinions and ideas about themselves, others and the world) as a reality. I would say this is the world of World 2. The world is what I think is experienced in the case of assimilation. 'The map is not the territory' is experienced in the case of accommodation.

From a *transitional point of view* this cross boundary of different facts, evidence may be a kind of conservatisms in the case of assimilation or a first beginning of change in the case of accommodation. A difference with the Zero learning and Learning 1 is that the repertoire of responding to different situations in the personal ecosystem is expanded in both cases.

Manifests of Learning 3: social learning, what, how we form meaning

The previous manifests of learning concern the reciprocal meaning making process between the internal schemata and information coming from the person's ecology, the network of relations in which a person is involved. It concerns the (World 1) of our physical environment and practice with the consequences of behaviour as a source for difference. So in the communication of perceiving a sign, which I interpret and choose a response that in turn again brings up a sign from the ecology which may give me the insight that it matters how I interpret the signs and

consequently choose a response. I may experience that in the assignment to learn history, it makes a difference if I choose to put the book under my pillow when sleeping, or drill the historical facts in my mind by rehearsing them, or try to understand what it is to think like historians when dealing with the subject I have to learn. Next, how I interpret the resulting grade for the history test in attributing it to my way of learning or to the difficulty of the test, in the way I will learn history the next time.

Learning 1 and in particular Learning 2 concerns the (World 2) of cognition of school learning where content is derivative from World 3 the conceptual artefacts and how these are reconstructed in the student's mind to be used for skill building and other learning purposes (Bereiter, 1994).

The next manifests of learning (learning 3) concerns the social learning and students working in World 3 – "(…) become familiar with the important World 3 objects that have already been produced and … learn to create new ones…" (Bereiter, 1994 p. 23). It involves working on improving the knowledge of World 3, even if their discoveries/inventions are not original. Hartmann, Angersbach, & Rummel (2015) emphasise the roles of social interaction as the centre of (Computer supported) Collaborative learning [(CS)CL] learning in their attempt to link these roles to different forms of constructivism. However, in their attempt they are too narrowly focused on the process of individual learning in social interaction in their categorization and miss a central issue of collaborative learning e.g. group cognition (Stahl, 2006, 2010). Learning 3 is also about the way we think, how we interpret signs, how we form meaning, the way we look at the world and how our mind makes a mental transformation. The 'form' of meaning making transforms (Robert Kegan, 2009) in order to create new understandings.

Concepts such as cooperative learning (Johnson & Johnson, 2009; Johnson & Johnson, 2002), collaborative learning (Stahl, 2006, 2010), expansive learning (Engeström, 1987), transformative learning (Kegan, 2009; Mezirow, 2009), trialogical learning (Paavola, Lipponen, & Hakkarainen, 2004), knowledge building (Bereiter, 2002; Scardamalia & Bereiter, 2006, 2010; Scardamalia, 2002; Van Aalst, 2009) are related to the manifests of learning 3. They all have social interdependency, social interaction, most of them have computer support and constructing knowledge. However, they differ in the degree of cooperation and collaboration: individual, group or collective knowledge construction.

Social interaction and Cooperative learning

Focussing on social interaction I can start with Bandura's modelling and social learning theory (Bandura, 1977). Where the different social interactions produce variations in individual learning (Hartmann et al., 2015), it is the learning of the individual by watching (cribbing), imitating, and taking over the behaviour of others and implicit values of the particular model, e.g. parents, teachers, others. This is the apperception way of learning (Simons & Ruijters, 2008). We see here social learning on an individual level, but not in the sense of collaborative learning. So let's take a look at more cooperative learning settings such as: Learning Together & Alone; Teams-Games-Tournaments (TGT); Group Investigation; Constructive Controversy; Jigsaw Procedure, Student Teams Achievement Divisions (STAD); Complex Instruction; Team Accelerated Instruction (TAI); Cooperative Learning Structures; Cooperative Integrated Reading & Composition (CIRC) (Johnson, Johnson, & Stanne, 2000; Loeser, 2008). Cooperative learning involves students working together to accomplish shared learning goals. (Johnson et al., 2000; Johnson & Johnson, 1999). Each student can achieve his or her learning goal if and only if the other group members achieve theirs (Deutsch 1962, as cited in Johnson et. al, 2000). Review studies show that cooperative learning significantly increases student achievement in comparison with competitive, individual learning situations. It does not mean that all operationalizations are effective in the same way (Johnson & Johnson, 2009; Slavin, 1980). From the above mentioned studies 'Learning together' seems to be the most effective (David W Johnson et al., 2000). The five most basic pillars of cooperative learning are: individual accountability, positive interdependence, face-to-face promotive interaction, group processing, and interpersonal and small group skills. Positive interdependence refers to the 'feel' of each other. Students feel that they cannot work without the participation of one or more group members. The central principle of cooperative learning is that students learn through interaction and dialogue with others, mostly in small groups, around a topic of study to achieve a common goal according to David Johnson[15] or Robert Slavin[16].

15 https://youtu.be/r_8uzEA0oWo?t=9 (retrieved October 2015).
16 https://youtu.be/OPc2mYftBDA (retrieved October 2015).

Reinterpreting

The *ecosemiotic process means taking a form of socioculturalism* (Bereiter, 1994). *'Learning with others'* enables a social interaction as a kind of "cognitive apprenticeship to learn the school learning material and enhance the individual learning (Hartmann et al., 2015). The social interdependence enables the individual motivation and cognitive learning (Slavin, 1980, 1996). What we see is that information, complex codes, models and scientific theory are interpreted and reconstructed by labour division in a group (Dillenbourg, 1999). It is the cumulative collection of interpretations of a group, not yet the group cognition (Stahl, 2006) of collective knowing. Or as Hartmann et al., (2015) interprets this as an endogenous form of constructivism: the source of knowledge construction is the individual processes. No new artefacts are created collectively. You can regard it as a kind of individual cognitive learning, manifests of Learning 1 and 2 on a group level where the social interaction scaffolds the individual interpretation of information. So reading a book with others gives you access to interpretations of information by others that helps you to reconstruct the knowledge represented in school textbook. This is because you see things you did not notice or others together contribute more foreknowledge than your own. Communication then becomes learning.

Because we have dealt with imitating or reconstructing the 'what' of the textbooks, *thinking the past*, the implicit thinking embedded in the 'what' that is learned will not be a focus so easily. On the one hand this is because it disturbs the completion of the cooperative learning task and on the other hand because it doesn't question the way of knowing; it focuses on what is known already. This form of Learning 3 does not easily goes beyond the practice (World 1) and the subjective learning in the mind of World 2 school books and standard tests. It is effective in an improved study achievement (David W Johnson et al., 2000). What *epistemologically develops* is an awareness that people think differently and interpret differently and you can learn from each other. Social interactive processes skills are learnt together with dialogue to cognize content.

For transition, entering into a dialogue with others is an important aspect in building new understanding. Communication becomes an explicit source and a sharing of different views on the world. This forms a first basis for a readiness to see relationships. It is important to identify which epistemic world is active in the dialogue,

if the dialogue is also entering into the world of conceptual artefacts (World 3), and if it goes beyond experience and (school) knowledge, manuals. The latter is less obvious in cooperative learning, but is evident in collaborative learning.

Collaborative learning

The difference between cooperative and collaborative learning is roughly described by Dillenbourg: "(...) in cooperation, partners split work, solve subtasks individually and then assemble the partial results in the final output. In collaboration, partners do the work "together" (Dillenbourg, 1999, p. 8). This doing together is according to Dillenbourg a process by which individuals negotiate and share meanings. The difference lies in the fact that in collaborative learning the knowledge construction is not an assembly of individual understandings, such as in cooperative learning, but collaborative, group interactions such as negotiations and sharing of meanings (Stahl, Koschmann, & Suthers, 2006, 2014). According to Beers, Boshuizen, Kirschner, & Gijselaers, (2005; 2008) collaborative learning can be characterized as social interaction focusing on the development of a common ground and shared knowledge. The two are formed through negotiation and knowledge exchange. This may be in a dialectic conversation of agreeing and disagreeing with messages, making your position known to group members, posting rejections to messages that are unintelligible or objectively incorrect in the eyes of someone else. A process from unshared knowledge externalisation to knowledge construction integration takes place (Beers et al., 2005, see fig 12). Despite this formalism of the process, their studies show different effects concerning, for instance, reaching a common ground (Beers et al., 2005). However, the main point is that groups are seen as a major source of knowledge construction with a social and interactive dimension (Miyake & Kirschner, 2014). This social dimension involves aspects such as interdependence, social and task cohesion, group potency and psychological safety. Often these social aspects are underestimated in (computer supported) Collaborative learning (CSCL) in contrast to co-construction and constructive conflict in the sharing and meaning making group process (Kreijns & Kirschner, 2003). In this social process learning ability in the sense of regulating content and community processes is vital for people to become used to share knowledge, deepening their own and common understanding and creating further insights (Laat, De Jong, & Huurne, 2000).
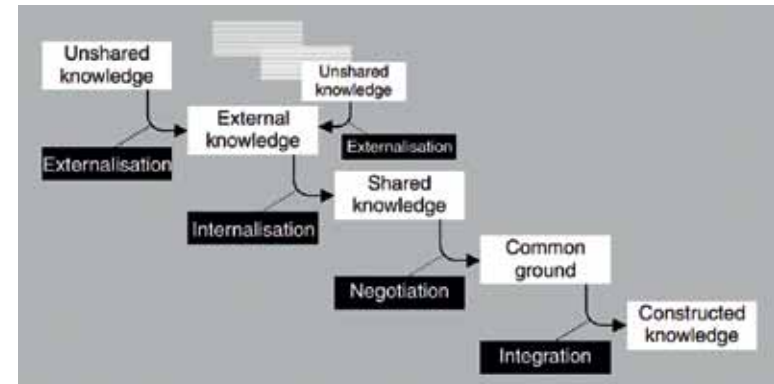
Figure 12: Collaborative learning has divers phases starting form unshared knowledge to constructed knowledge (Beers, Boshuizen, Kirschner, & Gijselaers, 2005).

Stahl (2006, 2010) emphasises much more the group cognition and collaborative knowledge building as the character of (CS)CL. I would call this kind of knowledge building rather 'co-creation' of knowledge. Stahl describes that this happens in an ecology where teachers act as facilitators and less as instructors or in the case of CS computer environment act to "supports the interactions among the students themselves" (Stahl, 2006, p. 3). According to Stahl, collaborative knowledge building is effective when the group is engaged in high level cognitions of "thinking together about a problem or task and produce knowledge artefacts like verbal problem clarification, a textual solution proposal, or a more developed theoretical inscription that integrates their different perspectives on the topic and represents a shared group result that they have negotiated"(Stahl, 2006, p 3).

Reinterpreting

I would characterize the *ecosemiotic process* in collaborative leaning like Hartmann et al., (2015) as a dialectical negotiating in small groups about the difference in signs, information, consisting of the different individual opinions, perspectives formed from individual ecosemiotic process based on their own experience (World 1) and information of schoolbooks (World 2), perhaps also scientific information (World 3) and the perspectives of others in the collaborative group. The sharing of the perspectives and the negotiation, debate, discussion is the process of finding common ground for the co-construction of a group knowledge perspective.

The interactions with others reveals the difference in individual perspectives, which form a source of knowledge. Hartmann et al., (2015) indicate this in the context of collaborative learning as a dialectical process. So a social interaction where the difference is synthesized in a process of thesis and anti-thesis becomes a group cognition. Others are important in (CS)CL in getting to know the difference between the various interpretations of individuals as a source to understand by negotiating them in group dialogue, debate, discussion and arriving at a consensus or perspectives of what a phenomenon, theory is about or what a creative solution is for a problem or question in the context of a learning or work task.

In the social interaction the personal practical experience (World 1) and the ideas of the personal subjective mind (World 2) become part of the collective conversation and knowledge construction process. This *thinking the past* may reveal different modes of thinking, old ways of looking at particular phenomena. In the first place this is in the ecology of ideas of the subjective mind (World 2).

Students *develop an epistemic awareness* of the common ground and subjectivity, the man-made character of knowledge artefacts.

From a transition viewpoint where multidisciplinary approaches are desirable (CS)CL has a high potential because of the negotiability of knowledge and the interdependent process of finding a common ground and cohesion in something such as group cognition (whatever this epistemological means). Learning becomes knowledge construction and is no longer a solitary individual process, but also a group process.

Knowledge creation/building
Knowledge building (Bereiter, 2002; Bereiter & Scardamalia, 2006a) or knowledge creation (Nonaka, 2006; Nonaka & Toyama, 2003; Nonaka, 1994) concerns the same processes, although knowledge building is more education related and encompass a greater range of concerns (Scardamalia & Bereiter, 2014). Both certainly consist of the social and group dynamic processes as is the case in collaborative learning. However, the latter does not always include the systematic, methodological, empathic and hermeneutic process of knowledge creation. In knowledge building the social interactions are also an enculturation in World 3. Despite the formulated collaborative learning formalizations such as scripts (Dillenbourg & Hong, 2008), roles (Strijbos, 2004) or or-

chestrating graphs and workflows (Dillenbourg, 2015), they don't support such an enculturation, but they do support the group process in (CS)CL. Tools in knowledge building environments support the development of ideas, theories, conceptual thinking and artefacts and enculturation in World 3. It refers to a set of social practices that advance the state of knowledge within a community over time (Paavola et al. 2004). The knowledge building principles are guidelines for idea improvement; they are not scripts, not linear steps to follow. The knowledge building principles "serve multiple purposes like pedagogical guides, technology design specifications, and evaluating 'existing' practices" (Scardamalia & Bereiter, 2010, p. 9).

According to Van Aalst, (2009, p. 260) knowledge creation involves more than the creation of a new idea; it requires discourse (talk, writing, and other actions) to determine the limits of knowledge in the community, set goals, investigate problems, promote the impact of new ideas, and evaluate whether the state of knowledge in the community is advancing. Van Aalst distinguishes three modes of discourse—knowledge sharing, knowledge construction, and knowledge creation. Knowledge sharing refers to the transmission of information between people. According to Van Aalst knowledge construction refers to the processes by which students solve problems and construct understanding of concepts, phenomena, and situations by making ideas meaningful in relating to prior knowledge and the problem situation mediated by social interactions within a group and technologies. Knowledge construction, with its emphasis on building on students' prior ideas, concepts and explanations, and their metacognition, produces deeper knowledge in complex domains than does knowledge sharing (Bransford et al. 1999; Hmelo-Silver et al. 2007). Van Aalst connects knowledge creation to expertise of the situations, and the requirement of environments (companies, organizations, academic disciplines) where ideas are needed to sustain innovative in order to survive as an organization, being an organic system in a big relational world.

The big difference with other cooperative and collaborative learning is that knowledge building takes you directly into the process of knowledge creation as the basis of education. It is 'acquiring competence in knowledge creation by actually doing it" (Scardamalia & Bereiter, 2014, p. 399). It is enculturating students in their role as collaborative knowledge creator in the sense of improving ideas. Knowledge building is much more an idea improvement centred process by means

of collaboration in advancement of a community. According to Scardamlia and Bereiter (2014; Bereiter, 2002) knowledge building derives from a Popperian epistemology e.g. Poppers "three world" ontology. Here World 3 consists of an objective knowledge world created by the human mind. It is knowledge in the form of conceptual artefacts which can be acted on as an object. So you can work with knowledge because you can grasp it, build on it, modify it and develop it further. This is different from co-constructing knowledge as in Collaborative learning.

In relation to education Scardamalia and Bereiter (2014) put forward 5 of the 12 principles as vital themes. 1) *Community knowledge advancement*. Knowledge is not a proposition of a person, but of a culture and community and it contributes to the wisdom of the community and its members. 2) *Idea improvement*. There is not such a thing as a final truth, perfect theory, technology or living together. It can always be improved. All ideas can be improved and in this sense all ideas are valuable. 3) *knowledge building discourse* as a creative role instead of a critical role and a collaborative process. 4) *constructive use of authoritative information*. This means all kinds of information, first-hand experience, secondary sources, etc, that has value in the knowledge building process in a constructive transliteracy practicing. 5) *Understanding as collaborative explanation building*: producing principled practical knowledge by connecting concrete experiences to more generalizable knowledge. Knowledge building is innovation, based on 'principle practical knowledge' and theoretical concepts in a coherent explanation for practical use (know-how combined with know-why).

Reinterpreting

The Popperian ontological World 3 underlies the *semiotic process* in knowledge building. This world makes understanding knowledge possible because we can grasp the knowledge in its form as a conceptual artefact. A concept that can be dealt with as an object, that you can work with, build on, modify and improve. An assumption is we can do this because the conceptual artefact's properties, connections and potentialities are independent of the mental state of the individual who had the idea (Scardamalia & Bereiter, 2014). However, as I noted before, every conceptual artefact is created by the (human) mind. One can't get away from this relationship. I'm not convinced that the artefact's properties are independent of the mind(s) who had the idea. The mind(s) who had the idea makes use of lan-

guage, codes, signs – cultural tools. By these, his/her or their thinking, his/her/their view of the world related to his/her/their being-in-the-world and changes of mental mind(s) are embedded in the out-in-the-world artefact produced by minds, just like a Trojan horse or a Stradivarius. In the first example you are held implicitly in the grip of the embedded thinking of the past, in the latter you hear the hand of the violin maker. No matter if the artefact concerns a scientific article, a dance, painting, music, poetry, technology or whatever. There is, for instance, no clear boundary between Dillenbourg's or Bereiter's and Scardamalia's pedagogical ideas on the one hand and the collaborative learning or knowledge building technology that is designed on the other hand. These "in-depth-links" are at its heart and "trigger different verbal interactions" of people using the technology (Dillenbourg, 2015, p. 193).

Indeed, the conceptual artefact as such form an independent entity, but not the codes, signs, language of the mind's thinking embedded in it. That is why I might not receive and understand the whole insight, understanding of Jeroen (Jheronimus)'s world, given by him to the community when looking at his painting The Garden of Earthly Delights (fig 13).
To arrive at a responsivity for the embedded codes, symbol, and signs, the artefact has to come into the mind again so that you can build on it. You have to stand in front of a Rothko's painting, according to his instructions as closely as possible, to become immersed in the life, the thought, the understanding of his world embed-

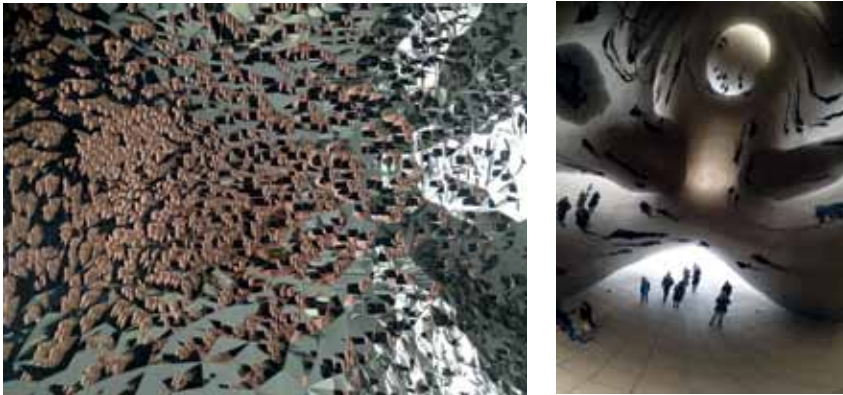*Figure 13: Jheronimus Bosch: The Garden of Earthly Delights*

Figure 14: Sculptures by Anish Kapoor. On the left 'Anish Kapoor in the Pont, Tilburg, The Netherlands, November 2012; on the right: "Cloud Gate' Chicago, Ilinois, USA, April 2015. (photos private collection).

Figure 15: Fragment of the dance 'Inside Out' by Conny Janssen Danst, 2015 (photo private collection).

ded in the artefact to experience the change in time, space and experience reso-nations of a reality. In this way you can experience the redefinition of essence, and perception of scale and matter looking at Anish Kapoor creatures (fig 14).

It is engaging, and distancing when looking at a dance of, for instance, the Conny Janssen Danst and you become immersed in the signs of the choreography 'Inside Out' to experience the resonance of reality that our behaviour, thinking is a detail of the complex, is prisoned by and has to break out of imaginary structures in which we feel comfortable and uncomfortable at the same time (fig 15).
Going into the artefact and the artefact getting into our minds is a process of trans-formation of our frame of reference. This process is a starting point for opening up our mind to perceive signs, codes and information as they manifest themselves in our problem, question, complexity. It is the process of noticing difference and po-tentials that we never perceived and understood before.

Looking at a theory is like looking at any other conceptual artefact. One has to be-come engaged and has to explore the thinking of theory. It is these kinds of know-ledge building *conversations with the others* in the artefact, and with others about the artefact in which relations, e.g. *differences come into language* in the conversa-tion. Not as an individual property of the interlocutors. 'What is', is 'laid down in the middle' as a 'rising above' in collective, in community, as a common language of collective understanding (a hermeneutic 'collective Verstehen'). A rise above as a common language of understanding in which the 'old thinking' is revealed in its in-clusive principles and higher problem formulations into new syntheses. Partners, knowledge builders, in the conversation, "transcend trivialities, oversimplifications and move beyond current (best) practice" (Scardamalia & Bereiter, 2010, p. 10; Scardamalia, 2002, p. 79). I agree with Gil-Perez (as cited by Van Aalst, 2009 p. 262) who interprets the 'Rise above' not so much as a principle. Gil-Perez indicates it as a cognitive act. I think it is indeed more than a principle. It is the process of ar-riving at a common language of collective understanding. It is a synthesis, leading to a new conceptual artefact to go public with and by doing this enriching the com-munity. The principle is the 'knowledge building conversation' which distinguishes itself from interpersonal dialectical dialogue, debate, discussion, etc. or from some-thing like a culmination to 'group cognition' (Stahl, 2006). I don't have the impres-sion that in the concept of group cognition differences exist between knowledge

artefacts and conceptual artefacts. The knowledge building conversation is not an adjusting to each other as partners in the conversation. Partners become engaged in the artefact, coming under the truth of the matter or praxis, under the resonation of understanding reality. A resonance of organic connectedness and dependency of our being as part of others and nature. Resonations that partners in the knowledge building conversation combine in a new common ground. In the 'knowledge-building-conversation' it is not merely against each other and putting your own positions forward, but a transformation into the common, into the collective. A transformation in which one does not remain who one was. (Gadamer, 1975, p. 360).[17]

The epistemic development being involved in such a process consists of the experience that language and knowledge building conversation are a medium for individuals to understand by collective understanding. It is the development of a language of understanding the difference. To learn thinking in organic systemic connectedness in which 'the' difference is a source for the interdependency of what we are and what is. Understanding that nothing is a thing, a problem, a situation, a person as such, but it is what it is because of the organic ever changing connectedness. A knowledge building conversation discourse is what Kegan indicates as an epistemic development in not only 'what' we know but also of 'our way of knowing' (Kegan, 2009). The restructuring of the frame of receiving an artefact of reality, making it possible to question facts, consider perspectives, biases and historical roots of thinking of who created the artefact. In the knowledge building conversation discourse you experience the cross boundary reconceptualization of object, motive and history of an activity of possible expansive transformations in an activity system by exploring the cognitive and emotional connectedness (Engeström, 2009; S. Paavola et al., 2004).

17 "Die Verständigung über die Sache, die im Gespräch zustande kommen soll, bedeutet daher notwendigerweise, da im Gespräch eine gemeinsame Sprache erst erarbeitet wird. Das ist nicht ein äu erer Vorgang der Adjustierung von Werkzeugen, ja es ist nicht einmal richtig zu sagen, Da sich die Partner aneinander anpassen. Vielmehr geraten sie beide im gelingenden Gespräch unter die Wahrheit der Sache, die sich zu einer neuen Gemeinsamkeit verbindet. Verständigung im Gespräch ist nicht ein blo es Sichausspielen und Durchsetzen des eigenen Standpunkten, sondern eine Verwandlung ins Gemeinsame hin, in der man nicht bleibt, was man war. "

Manifests of Learning 4: transition of receiving

This learning manifests itself as a transformation of the capability to receive signs. Bateson (1987) speaks of a combination of phylogenesis with ontogenesis. It concerns how our learning changes our capability, sensory modi, to receive signs. Although the biological evolutionary process may result in this, it will take a long time. Learning 3 may result in the development of sensory tools. This is often imitated from understanding nature (biomimicry) such as in radar, echography, infra-red perception. These technologies expand our capability to receive signs or code from our environment. Also (deep level) meditation can have a similar effect. During meditation the daily overload of information is set aside. Meditation frees the mind to receive the signs in a pure way, which may lead to a new and different understanding.

Pondering

From a distance (for a summary see Appendix A) one can see that learning manifests itself in three ways: Zero learning and Learning 1) natural biological learning in daily practice; Learning 2) cognitive learning in schools, courses, trainings; and Learning 3) social interactive learning in groups, teams, communities (see fig. 16)

The three differ in the way they are connected to the practice and the world of conceptions. They differ in the nature and depth of understanding and their transformational character. They differ in their impact from a transition viewpoint.

However, I still think there is not such a thing as an order, level or taxonomy of learning. For me it is a kind of 'old' thinking. Ordering gives us a particular insight in reality. Is such an ordering sophisticated enough to understand learning in relation to the perspective that learners are part of an ecosystem? A more relational network view seems more realistic. Learning goes on all the time. It never stops. It is an ontological character of living beings. And learning is always an interaction with one's environment. The beating heart in all learning is the eco-semiotic process of meaning making.

It is great that we don't have to think every minute in full awareness when we eat, but we start to blow on our food to cool it when it appears to be too hot to eat.
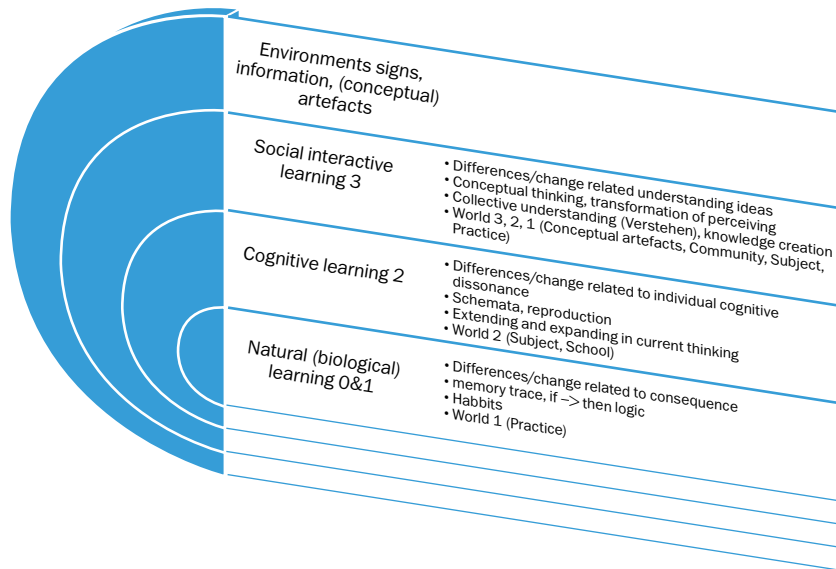
Figure 16: : Overview of the three manifests of learning and their main characteristics concerning semiotic process, what thinking is learned, the learning outcome and connection to Popper's World 1, 2, and 3.

That our thoughts change if we notice that the blue colour cake is actually unexpectedly delicious. That you can really enjoy eating insects like mealworms on a bar of chocolate. When discussing this with my family during dinner, supported by the information on the internet and a cookbook, we came to a group understanding that mealworms could also be seen as food. And by entering into a real conversation we even create new insights and understanding of proteins or how this food could contribute to solve protein shortage in the context of feeding a world population, decreasing poverty and maybe more. It makes a difference if I have these knowledge conversations with my family or with food experts, econometrist, medical experts, sociologists, food processing producers, farmers or a heterogeneous group of different disciplines. The context of the conversation influences the process of knowledge creation when we are talking socially over dinner and about the dinner, or when we are talking professionally about new technologies for the future in a project such as vertical farming (Despommier, 2013; Oskam, Lange, & Thissen, 2013).

Learning as an ontological eco-semiotic process makes us aware of our interaction with the world in which we live. How learning manifests itself depends on the particular situation and epistemic character of our environment. It makes a difference if we can do this together with others or alone. It makes a difference if we have to reproduce, to know or to understand information, or if we have to explore the essence of a phenomenon. All of this makes a difference for what we understand collectively as community and individual as part of your ecology.

We probably need all kinds of learning to survive, especially as a culture, community, a species. The semiotic process as 'the difference that makes a difference' has distinctive groundings in each kind of learning. The resulting change and impact in practice of the learning is directly proportional to this grounding.

So the impact is more on the individual behaviour, individual cognitive or the societal level. Nevertheless, the community or societal level also influence the understanding of the individual. However, because learning zero and 1 also influences the environment, it may have an impact on the societal level as well. So the different manifests of learning are not discrete, but are inter-related and influence each other in hindering and stimulating us to see the difference that makes a difference for transition.

Where learning and transition come together, the idea is formed that responsive education is not only about becoming more knowledgeable and seeing the inter-relations as in interdisciplinary thinking (Spelt, 2015), but also that building this knowledge enriches students to see their world differently. In responsive education students' epistemic beliefs change, resulting in a different way of interpreting their environment. Responsive education supports learning as a change of students' conceptions, their ideas, e.g. to discover 'a difference that makes the difference, which is an idea, a bit, a unit of information' (Bateson, 1987, p276) a change.

It is about learning to see the world of relations, of interdependency in the communicative 'meaning making', as a process of interpreting the difference between signs of their ecology to determine what counts for nature, and for a human and nature friendly culture of living. Responsive education is about understanding ('Verstehen'), the consequence of relationships. This is what Sterling, Maiteny's, Irving, & Salter (2005) indicate as 'linking thinking'.[18] In responsive education it is not only about organizational, learning, teaching and schooling flexibility, student centred, etc. The essence, in the context of transition, is what kind of thinking, knowledgeability we teach when we educate students. Responsive education goes beyond teaching analytical, methodological and critical, linear logical thinking. It is teaching and learning to think in a network of dynamic relations resulting from a process of interaction. Interactions within Poppers World one, two and three where students, as being part of these worlds, together interpret signs of their ecology and impose meaning on reality by traditions of thought, language and actions. In return their ecology imposes meaning by signs. In the context of the progression of mankind in solving the complex dilemmas or in more concrete terms in the context of the five professoriates concerning transition in the food and agricultural sector[19], responsive education goes beyond the standards and performance debates (Röling & De Jong, 1998). It concerns the intimate nature of

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18 Linking Thinking is an excellent book for teachers and people involved with learning for ecological thinking of sustainability filled with practical augmented ways on how to work on system thinking and holistic thinking to complement critical and analytic thinking aiming at more holistic, systemic, ecological, inclusive and integrative thinking.

19 Five professorates food & agriculture: Cyclical use of resources on the sustainability of production systems; Business models and personal leadership in the circular economy; Experience and Wellbeing, on the sustainability of consumption; Success and failure of social innovation and life style; Responsive learning for a reflective and innovative biobased society.

Part 3
Done and what to do?

learning and the teaching of a different, transitional, kind of thinking and ecological awareness, thinking, interpreting differences in signs and acting.

Responsive education deals with four crucial ideas in learning and teaching:

1. *Agency*: more control for students of their mental activity (Bruner, 1996; De Jong, 1992) and improving students' own ideas (epistemic agency; (Bereiter & Scardamalia, 2006a; De Jong, 2006; Scardamlia & Bereiter, 2014):
   Students have ownership of their learning and ideas.

2. *Culture*: 'coming into language' of how the way we live and think and construct thought are embedded in the knowledge we claim as 'reality' and how our mind set perceives and interprets signs in the ecology we are part of (Bateson, 1987; 'reflection; knowledge is justified belief', Bruner, 1996; 'rethinking assumptions', Sterling, 2009):
   Students question presumptions and 'realities' of what they learn.

3. *Learning together*: creating meaningful connections between individual and society by 'coming into presence' into an intersubjective space (Stroobants, & Wildemeersch, 2001; Wildemeersch & Stroobants, 2009). The sharing and negotiation of meanings to construct shared conceptions (Charmaz, 2014; Dillenbourg, 1999; Stahl, Koschmann, & Suthers, 2014); explanatory coherent practical knowledge, combining 'know-how and know-why' aiming at solving problems, guiding practice. Understanding through collaborative explanation (Bereiter, 2014; Scardamalia & Bereiter, 2014).
   Students build new meaning together for solutions.

4. *Knowledge building*: not simple 'learning in the raw" (Bruner, 1996), 'rote learning', reproducing or solving a well-known problem, but a semiotic process of entering into a collective understanding, grounded in the consequences of the system of relations that makes a difference for life. ('community knowledge advancement'; conceptual understanding, enculturation in the world of creating knowledge; Scardamalia & Bereiter, 2014; Bereiter, 2002; De Jong, 2006; cultural artfacts, Stahl, 2006).
   Students learn together and go beyond what is known and done.

How do these crucial ideas enter language in teachers' interests, their passion for teaching, their questions, their drive to improve their teaching and education? I cannot answer these questions directly, but the research done by our teacher-researchers may give us some insight into this. I describe different experiences in the next section.

Some of our experiences

A lot of teacher research has been done in the professoriate 'Knowledge creation and ecological intelligent thinking'. This section does not aim to present them all, but I would like to highlight some of them in relation to what I have said in the preceding parts and give an impression of where we come from and where we are. Although I'm connected to the knowledge building already from the '90's, Stoas is connected from 2006 when I started my professorate in 2006.

A teacher-researcher right from the very beginning is Bert Reijnen. When he participated in the IKIT Knowledge Building Summer Institute 2006, he was convinced that he wanted to do something within his practical work with knowledge building. So we both studied how Bert put this into practice. Parallel to a knowledge building group (N=10 3e year student-teachers 'vocational agricultural education') a comparable group of (N=26) students followed the same professional situation, in the regular approach. The latter concerns a dual situation of teaching in agricultural secondary vocational schools, following supportive 'lessons' and 'elaboration time', to work on topics or related learning tasks. In contrast the Knowledge Building group used the elaboration time to work on their own ideas of 'coaching pupils' and used the supportive lessons as 'expert' input for their ideas.

Bert discovered that knowledge building bridged the gap between higher education and the internship of student teachers and leaded to a deeper understanding on different levels. Therefore after 15 weekly meetings over a period of five months the Knowledge Building group and Bert as teacher-researcher concluded that the following levels of deeper understanding were achieved (Reijnen & De Jong, 2007) (see fig. 17):

1. *Understanding*: Knowledge Building and Knowledge Forum
   Students were easily motivated to work with the Knowledge Building approach and the Knowledge Forum facilities. Working and discussing together we discovered the difference between shallow and deep constructivism and working in design mode instead of belief mode (Bereiter & Scardamalia, 2006b).
   Quote by students Annelies and Bart: "By reading the notes and opinions of others we are able to review our opinion and we can try out another approach. It enriches our possibilities and we become more expert on coaching pupils".
   [Learning together]

2. *Deeper understanding of learning processes*
   Although "learning processes" were not the subject of the students' attention (this was coaching pupils in vocational education), we developed a different approach of competence based education. In the Knowledge Building time the issue was improving ideas of coaching as experienced by students during three days a week at schools. The learning process shifted from task and activity-oriented to idea improvement and cognitive responsibility (Scardamalia, 2002).
   Quote by student Ellen: "Working with Knowledge Building changed my attitude from 'what do they want me to do for school?' to 'how can I be a better coach for my pupils and what do I have to learn for that?" [Agency]
   As they came closer to the end of the curriculum, students became more and more responsible for their own learning. This was an attitude achieved by a process that we discovered together: students, teacher-researcher and myself.

3. *Deeper understanding of competences*
   Competences to build (i.e. recognize problems from child-behaviour; coaching dialogue; professional distance; building and keeping a good relation with a child; etc.) are rather vaguely described in levels to achieve. Working with the idea of coaching and the need to make clear what these competences are about, gave students a deeper understanding of the competences. (Moves in the direction of culture and implicit thinking coming into language).

4. *Deeper understanding of the changing role of the teacher*
   Competence-based education is a new way of learning. It requires the teacher to play a different role. In addition to being an expert, the teacher's role is also

that of the facilitator and stimulator of the learning-process. While working with Knowledge Building it became clear that at the start students still expect tasks and activities to perform. Strangely enough students still show a dependency in their behaviour on teacher regulation by compulsory learning task assignments, although in our competence directed educational process we assume a student agency. During the process it became clear to Bert that the behaviour of him as a teacher should change from a type A or B teacher (giving explicitly or implicitly no strategic cognitive activity to the students) to a type C teacher (coaching and supporting students to become self-responsible for their knowledge creation process (Scardamalia, 2002). This kind of change in the language use of the teacher is also visible in the research of Walsweer, (2015) where a knowledge building environment is implemented in primary schools by focussing on changing the language used by students and teachers.
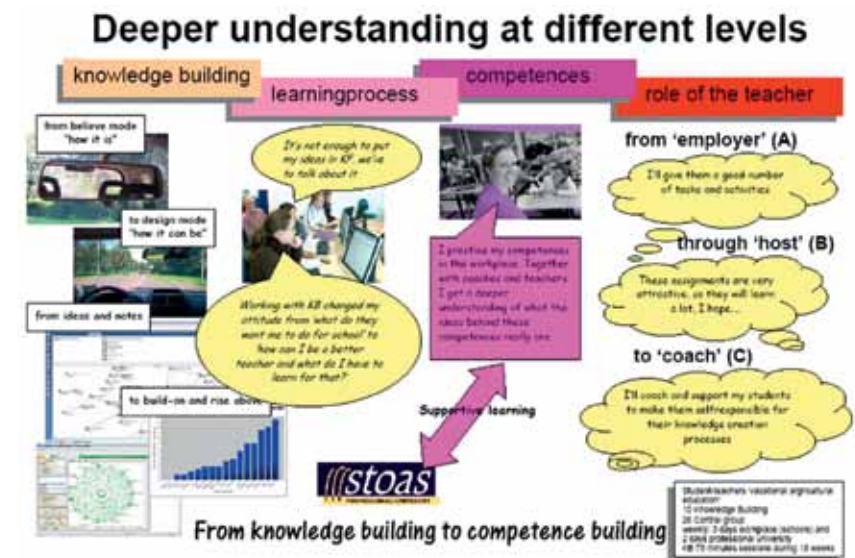

Figure 17: Deeper understanding at different levels by knowledge building (Reijnen & Jong, 2007).

The following year Bert discovered that knowledge building is all about Ideas, Agency and Learning (knowledge building) community (see fig. 18). Actually we see here three of the four crucial ideas that have been mentioned in learning and teaching: agency, learning together, going beyond 'raw learning'.
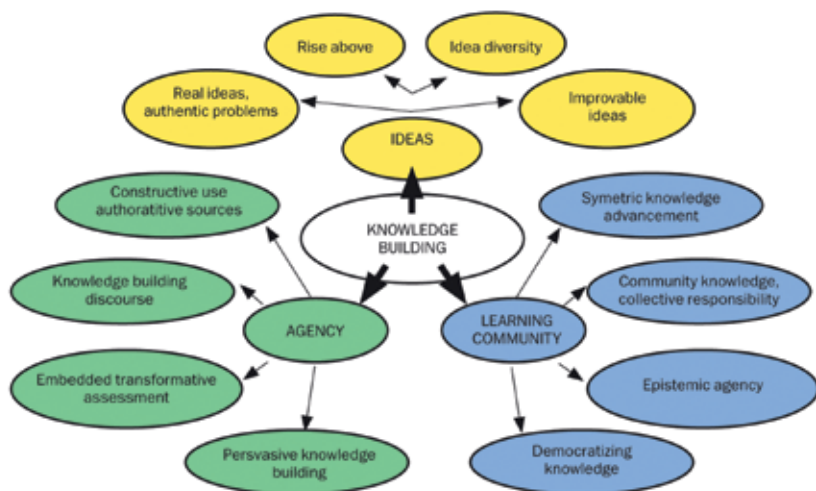
Figure 18: Agency, learning (knowledge building) community, and working with ideas as three crucial knowledge building elements (Jong, Reijnen, & Boshuizen, 2009; Reijnen, 2009).

Figure 19: Knowledge creation spiral process steps related to the knowledge building principles (Jong, Reijnen, & Boshuizen, 2009).

We noticed that students and other teachers needed some 'process navigation' structure to bring practice and idea improvement together. Together with our colleague Peter Boshuizen, Bert developed the knowledge creation spiral in connection with the knowledge building principles so students and teachers could gain a concrete grasp of the principles (see fig. 19). Bert and Peter elaborated together a complete guide that consisted of a set of guidelines for students and teachers with coaching interventions/remarks and possible didactical arts for each knowledge building principle (see appendix B).

The work of Bert and Peter helped us a lot in those days to implement knowledge building in a part of the regular curriculum 'Stoas Vilentum at Vilentum' location Dronten[20]. However, this concerned our own teacher education curriculum. What about secondary vocational schools where our students become teachers, what principles of knowledge building do we see there?

Ewald Nijenhuis, one of our teacher-researchers, taught chemistry to secondary vocational school students by letting them 'learn together', a subject he is passionate about. As a teacher-educator he wanted to know why he obtained such positive results with 'learning together' as a teacher in secondary vocational education. The depth of the secondary school students' observations in the chemistry lab, analyses and conclusions were impressive according to Ewald. He wanted to share these experiences by founded insights, with the teacher-students in his current work as teacher educator and teachers in secondary vocational education. Just like others in collaborative learning, Ewald wanted to connect producing new solutions, procedures, or systematic transformations in organizational practices and the learning together (collaborative learning) that produce this (Engeström et al., 1995, 1999; Sterling et al., 2005). In these contexts Ewald became attracted by knowledge creation and cycles of knowledge
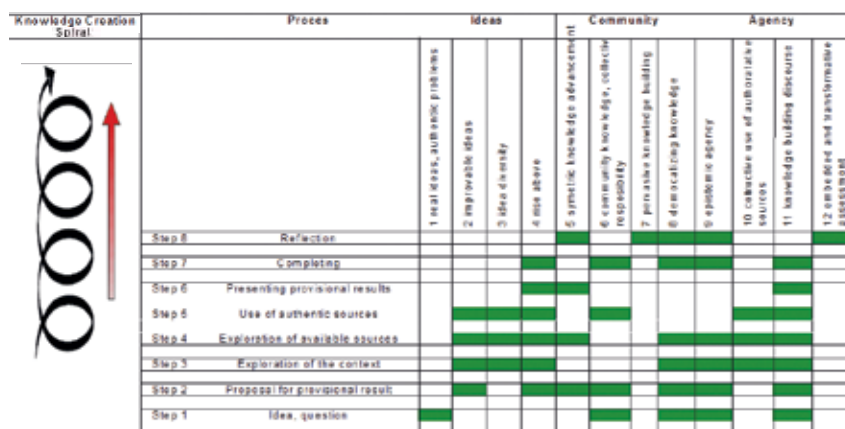
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20 Stoas University Dronten (north of the Netherlands) and Stoas University 's Hertogenbosch (south of the Netherlands) have merged and relocated in Wageningen (middle of the Netherlands) since 2011 and are located in the New building at the Mansholtlaan since 2013.

production of Nonaka and Takeuchi (see fig. 20) and the activity theory work and expansive learning cycle (see fig. 21) (Engeström, 2009; Engeström, 1987). Nonaka and Takeuchi describe a process that begins with socialization and the sharing of tacit, sympathized knowledge, followed by a phase of explicit conceptual knowledge (creating concepts maps); the concepts are then justified by combining and constructing systematic knowledge and finally this is converted into operational and internalized knowledge. The process is divided into building an archetype and cross-leveling knowledge.
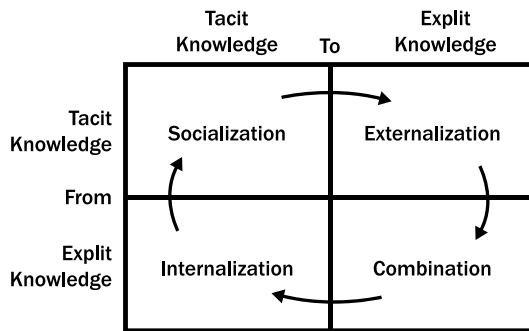
Figure 20: The cycle of four modes of knowledge conversion (adapted from Nonaka and Takeuchi, 1995)

Engeström's expansive learning cycle is based on the six learning actions of Davydov (1988, as cited in Engeström 1999), but Engeström added the critical questioning, action 1 and reflection actions 6 and 7 which evaluate and consolidate the insights in a new form of practice. The learning cycle cannot be separated from Engeström's system approach by his activity triangle and his so-called change labs (Engeström, Virkkunen, Helle, Pihlaja, & Poikela, 1996) (see fig. 21).

Nonaka's et al. and Engeström's approaches of collaborative learning, as knowledge building processes, focus on creating new (knowledge) practice by a process in which the difference is coming into language. They start 'from two beginnings', each having its own authority (Bateson, 1987; p6): the observations (the practice) and the fundamental knowledge, e.g. the World 3 conceptual artefacts, what we know formally, theoretically.
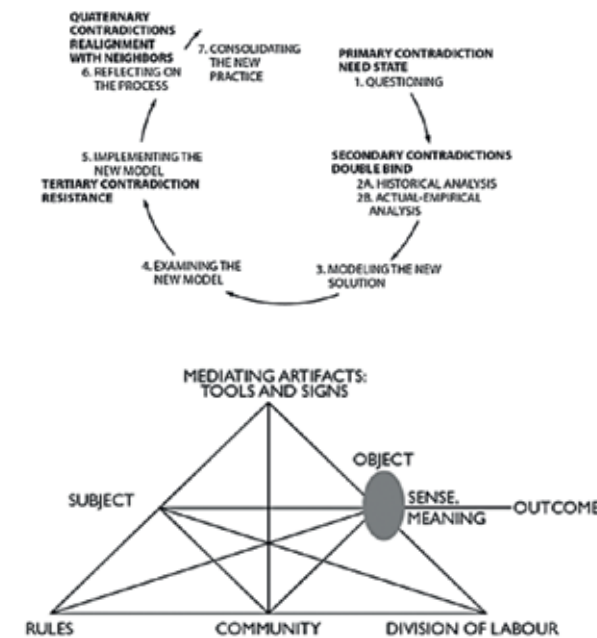

Figure 21: Engeström's expansive learning cycle / The six learning actions of Davydov and the Cultural Historical Activity Theory (CHAT) activity triangle, system model (Engeström, 2009).

At the 2010 knowledge building Summer institute Ewald (Nijenhuis & De Jong, 2010) came in contact with Sami Paavolaa and Kai Hakkarainen, the founders of the trialogical learning concept and involved in the Knowledge Practice laboratory project (KPlab[21]). In the knowledge creation metaphor (Sami Paavola & Hakkarainen, 2005) and trialogical learning (Sami Paavola, Engeström, & Hakkarainen, 2012) Ewald found what he was looking for. Namely, that besides knowledge acquisition by individual learners (a "monological" approach) or participation to social interaction (a "dialogical" approach), one should distinguish a "trialogical" approach, i.e. learning as a process of knowledge creation which concentrates on mediated processes where common objects of activity are developed collaboratively. The trialogical metaphor (fig. 22)[22] helped Ewald to elicit and understand processes-

21 http://kplab.evtek.fi:8080/wiki/Wiki.jsp?page=Main
22 http://kplab.evtek.fi:8080/wiki/Wiki.jsp?page=KnowledgeCreationMetaphorOfLearning

es of knowledge advancement. It showed him what the merging of the three approaches can look like: knowledge-creation, i.e. Bereiter's knowledge building, Engeström's expansive learning, and Nonaka and Takeuchi's organizational knowledge creation.
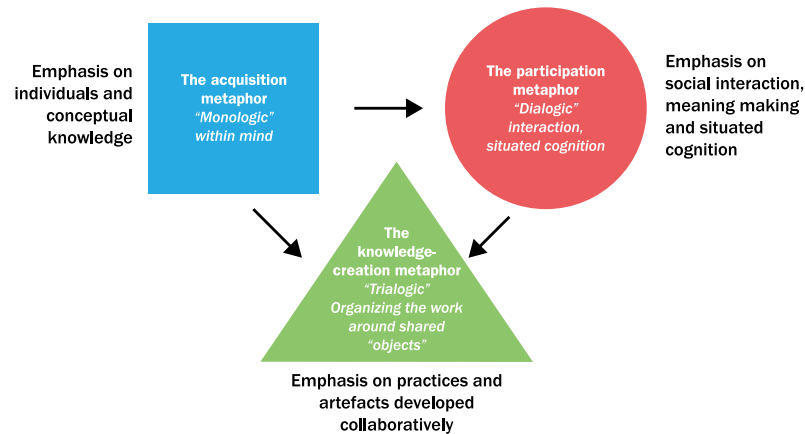

Figure 22: The trialogical metaphor KP-Lab Wiki (Paavola, S. & Hakkarainen, K., 2005). http://kplab.evtek.fi:8080/wiki/Wiki.jsp? page=KnowledgeCreationMetaphorOfLearning (retrieved October 2015).
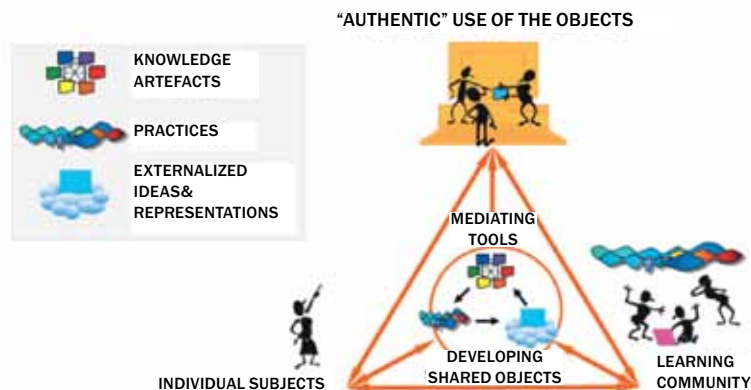
Figure 23: An illustration of the trialogical learning approach to learning presenting it's basic elements (S. Paavola & Hakkarainen, 2009). http://kplab.evtek.fi:8080/wiki/Wiki.jsp?page=TrialogicalLearning (retrieved October 2015).

In trialogical learning the focus is on learners (the subjective knowledge creation, World 2) on social processes or dialogues (learning together), and on jointly developing 'objects' (knowledge artefacts, processes or practices; World 3) meant for authentic use of objects (World 1) (Paavola & Hakkarainen, 2009; Paavola & Hakkarainen, 2005; see fig. 23).

Ewald formulated statements understandable for secondary vocational students, based on some of the trialogical design principles, these being the common features of Nonaka, Engeström and Bereiter's approach which had similarities with the ones listed by Paavola et al. (2004, p 562) and revised by the KPlab research concerning trialogical learning (Ewald's statements within brackets and italic[23]):

- (DP1) Organising activities around shared 'objects'. (*The feeling that everyone is working together on an idea or product-development*).
- (DP2) Supporting integration of personal and collective agency and working through developing shared objects. (*Entrepreneurship: self-, co-regulation and agency by the group*) (*Making mistakes is acceptable as long as you and the group learn from it*).
- (DP3) Emphasising development and creativity in working on shared objects through transformations and reflection. (*Deliberately speak to collaborate on new ideas*).
- (DP4) Fostering long-term processes of knowledge advancement with shared objects, artefacts and practices (*Working together in small steps provisional (intermediate) products that enhances every time*).
- (DP5) Promoting cross-fertilisation of various knowledge practices and artefacts across communities and institutions.(*Collaboration with many different people in the group and outside the group*).
- (DP6) Providing flexible tools for developing artefacts and practices. (*Working on real-life, challenging ideas from practice and not at school (book) subjects*).

Ewald (Nijenhuis & De Jong, 2012) used the statements in a ranking order questionnaire and group interviews with secondary school students (N=32 age 18-21), their 7 teachers coming from 3 schools. In addition to the statements, Ewald used

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23 Some of the statements are also related to literature on the social behavior of primates (Waal, 2009) and innovation management (Gasperz, 2002).

video recordings of student negotiations when learning together and Ewald analysed the course description and curricula documents. When students were asked to rank the statements in relation to being a success factor for 'learning together', they gave the highest rankings to: 1) *Working on real, challenging ideas from practice and not at school (book) subjects),* real roles and authentic, real and complex products; 2) *Entrepreneurship: self-, co-regulation and agency by the group*, space for independent and flexible work and clear accountability; 3) *Making mistakes is acceptable as long as you and the group learn from them.* The interviews revealed that failure tolerance, i.e. making errors negotiable and acceptable, also makes learning visible. The interviews showed that teachers scaffold students' choice moments in the whole process without taking over the responsibility of the process. Students who were less familiar with learning together asked for more structure and scaffolding (see fig. 24).
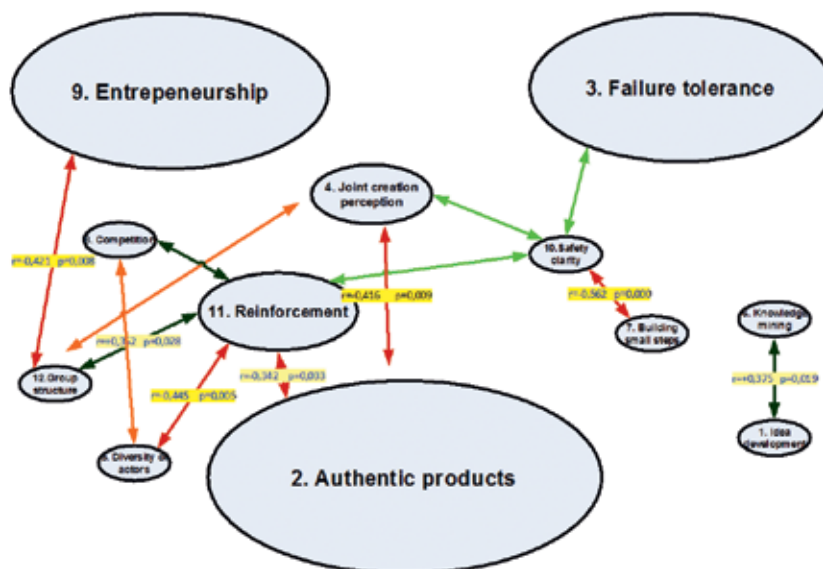
Figure 24: The bigger the balloon, the higher the rank students gave to the statement as being an important factor for success in their learning together. Dark red arrows indicate a negative correlation and dark green arrows a positive correlation. Light red (orange) arrows indicate negative and light green positive augmented relations during the interviews for instance "competition hinders joint creation perception" (Nijenhuis & De Jong, 2012).

The study results show that agency, and a real-life problem to create a shared solution for and the possibility to go into a perception, are more or less present. Culture is less obvious, meaning that schools probably work with authentic tasks and 'learning together', but not in a critical reflection if the thinking and solutions takes into account environmental consequences. The fact that 'reinforcement' cannot be overlooked is seen when working with real practice education where there is also a dimension of learning from consequence e.g. conditioning, acquisition of the responses deemed correct in the given context.

The finding that 'real life' problems are important for 'learning together' is congruent with the larger scale teacher-PhD-research of Hans Corten. Hans studied the Competence development and labour market benefits of internationally mobile students (Corten, 2014). Hans's studies show that international students in competence directed education, where real life problems are at the heart of the curriculum, have a higher competence level in contrast to their peers who stayed at home and followed content oriented university education. Hans determined that the international students who followed a year of competence oriented higher education in the Netherlands increased the competence 'to organize', 'to present', 'to co-operate' and 'to self-direct' significantly more than their peers in their home country.

This study also shows that in higher education more real-life issues and focussing more on competence rather than solely on curriculum content also contributes to the ability of students to cooperate together and to take agency in their learning.

The competence student diagnostic questionnaire developed by Hans was based on our 4Cyourway competence framework (De Jong et al., 2008; http[24]). In the design team together with others[25] Lia Spreeuwenberg was in-

24 http://www.4cyourway.nl retrieved October 2015.
25 Frank de Jong Lector Stoas Hogeschool & CAH; research management; Frank van den Dungen Helicon Opleidingen ; Cees de Jong Ver. Buitengewoon Groen, CPS; Wiggele Oosterhoff CAH Dronten; Dinand Ekkel CAH Dronten; Lia Spreeuwenberg Stoas Hogeschool; Renate Wesselink WUR; Marjan van Lunter AEQUOR; Agnes Jansen AOC-Raad

volved as a teacher-researcher. 4Cyourway is an overarching system of competence language developed in a design based study with vocational teachers and lecturers in order to describe complexity levels from the diploma level of pre-vocational secondary education (in Dutch: VMBO), through medium vocational education (in Dutch: MBO) and bachelor degree at the Universities of Applied Sciences to master degree at the Scientific University (De Jong, Corten, & De Jong, n.d.; De Jong & De Jong, 2008). The framework gives students a developmental perspective and insight into their competence growth. The framework uses 11 indicators to describe the complexity levels of 25 competences for 11 educational levels. At all complexity (education) levels a description of every indicator is available. The "4Cyourway" uses scales that are comparable to the scales of the Occupational Information Network (O'NET) of the US Department of Labour/Employment and Training Administration. O'NET uses 7 levels with descriptions of tasks that are relevant for each level. To describe one task at a certain complexity level, "4Cyourway" combines several indicators. Using several indicators to describe one complexity level is in line with the arguments of Hager (2004) who concludes: "the real world practice is holistic in that it often involves simultaneously a range of performance descriptors". The "4Cyourway" reference language is holistic, in the way that several aspects of the professional task can be described simultaneously.

On the basis of this framework I developed a self-perception instrument on the same systematic basis as that of Hans I used it in a study where (pre)secondary vocational students (N=79; 14.9 of age (sd, 0.9)) carried out 'research' in order to find answers to questions formulated by companies. This student research in and for companies was instead of regular internships[26]. Over a period of two years we followed the students as they developed the following related competence: Collaborating and consulting; Investigating; Planning and Organizing; Formulating and reporting; Dealing with pressure and adversity; Analysing; Deciding and Initiating; and Presenting. Also in this study the students

26 Thanks to AOC-Oost locations Almelo and Doetinchem and AOC-Terra we were able to study in the context of the reform Green Lyceum, and acknowledgement for the HPBO-financial support of the project 'Praktijk als leidraad in en doorlopende leerweg' (Practice as a guide in a continuous learning path).

involved with the inquiry and real-life issues and acting in real-life context had a better competence development than the control students (N=30) who followed regular competence curriculum with less authentic context. From the point of 'agency' development, this study confirms Hans's finding of an improved student agency and collaboration ability.

The studies of Hans and myself show that the ability of students to take agency and co-operate increases when the curriculum is competence oriented and deals with more real life problems and issues. From a transition point of view, it is useful to know that practice is needed in developing epistemic agency, putting forward your own ideas, as the basis for idea improvement and related practice.

Let us return to the result in Ewald's study that students who are unfamiliar with learning together ask for more structure and mediating support. As a teacher-researcher Johan Bijzen (Bijzen, 2014) studied mediation by teachers in the first year pre-secondary vocational classroom. Johan was inspired by Feuerstein's theory in the context of teachers coaching their students to regulate their learning, e.g. learning to learn. The aim here was that students could take more agency in their learning process. Johan gathered data by interviewing pre-secondary vocational teachers, video recordings of their interactions in the classroom and the first year prevocational students (age 12-13) filled in questionnaires. The interviews, questionnaires and data analyses where based on mediation characteristics as interpreted by Johan:

1. The teacher tells the student the purpose of the lesson (intention).
2. The students is open minded to what has to be learned (scholar reciprocity).
3. The students experience the usefulness of the scholar (spontaneous sense of purpose).
4. The teacher gives the meaning (meaning-based).
5. The students contribute their knowledge (tap prior knowledge).
6. The teacher and / or students connect what is learned in class to the application outside the classroom (transcendence).
7. The teacher helps the students to be aware of their experienced learning success (competency).
8. The teacher helps students learn to regulate their learning (controlled behaviour control).

9. The students take responsibility for their learning (spontaneous behaviour control).

Johan found, among other things, that teachers already have a more or less mediating role, but they are unaware of it. When they become aware, teachers see possibilities to expand their learning to learn mediation. Also students themselves do find it difficult to bring their learning into language in contrast to how easily they can tell how teachers teach. If they did not understand something in their lessons, it was difficult for them to come up with how to solve this without the support of their teacher. Teachers in their turn responded quite easily to the needs of these students, but were hindered by standard teaching methods.

Johan's findings are congruent with a large-scale teacher-PhD-research project by Jantine van Beek (Van Beek, De Jong, Minnaert, & Wubbels, 2014; Van Beek, De Jong, Wubbels, & Minnaert, 2014). Jantine discovered that there are no stereotype teachers as they are only content and knowledge transfer oriented on the one end of the continuum and student centred, learning to learn oriented on the other end. Jantine's studies shows that teachers combine instructing content and the information processing of their students with stimulating motivational and strategic learning to learn. This agrees with what Walsweer (2015) discovered that students and teachers in one single discussion alternate between participation frameworks (monologic, restricted interactive, dialogic and discussion). However, Jantine discovered that there are teachers who combine a lot and there are teachers who show this broadness of teaching activities to a lesser extent. This finding contradicts the existence of type A, B and C teachers which Bert was talking about in his experience of implementing knowledge building in his courses. The finding agrees with the findings of Leeuwen (2015) that teachers in CSCL use a wide range of interventions across time and between groups. They focus on cognitive and metacognitive skills and less on social and metasocial activities.

More in-depth analysis of teacher-student interactions showed that only a few teachers explain the why, the motivational and metacognitive reasons, in the learning to learn interactions. Learning to learn appeared mainly to be a matter of instruction, rarely accompanied by an explanation of the how and why of particular learning activities (Van Beek, 2015).

The insights of the above studies helped us[27] to develop a two-year part time Master of Education programme, Master Learning and Innovating (MLI), for teachers working in pre- secondary and higher vocational education and people who are involved in learning for the profession in business[28]. The two-year programme is based on knowledge building (Bereiter, 2002; De Jong, 2006). Teachers and students guide themselves with the metaphor of progressive inquiry learning (see fig. 25) (Hakkarainen, 2003a, 2003b; Muukkonen, Hakkarainen, & Lakkala, 1999) and the knowledge building principles (Scardamalia & Bereiter, 2010; Scardamalia, 2002).

For the last two years the MEd programme has been proclaimed (2013-14; 2014-15) as one of the TOP Master programmes in the Netherlands. The indication is

27 Frank de Jong, Madelon de Beus, Tom van Oeffelt, Hennie van Heijst, Ard Sonneveld, Hanneke de Laat, Lia Spreeuwenberg, Loes Spit, Ilya Zitter, Joan van de Ende, Niek van Benthum, Jantine van Beek, Niek van den Berg. I hope in the upcoming years also Elsbeth Spelt, future colleagues and guest teachers.
28 The field research of Marjo Frenck and the description of the theme 'Environment' by Arie de Jong also contributed to the development of the master program.

Figure 25: Progressive inquiry and distributed expertise. (Muukkonen et al., 1999).

based on national NVAO[29] accreditation results and the opinions of students in a national inquiry.

In teaching this two-year curriculum for the 6th year now, we have built up a lot of experience. Some of the main experiences are:

- *From the collective to the individual:* 'learning together' is easier if students form groups on the basis of their own ideas and find an underlying and practical related common issue, or question to work on together. They then study the literature and acquire practical knowledge not in order to validate their own conceptions, but to contribute to the common issue which is collectively under study.

- *Heterogeneous groups:* If students from different ecologies, in our case from education and business, are in a group, the implicit culture of thinking is easier coming into language.

- *Two beginnings:* Students build up common knowledge by taking literature and empirical observations in their work context as the starting point. This stimu-

29 The Accreditation Organisation of the Netherlands and Flanders (NVAO).

lates thinking about the signs in the literature and the signs coming from their practical experience and facilitates interpretation of the differences in terms of the potential a theory has in practice.

- *Conceptual artefact:* By interpreting the signs from theory and practice, students collectively build a model, for instance a model of learning, e.g. students 'rise above' to a higher conceptual level.

- *Going public:* The collectively conceptual artefact, is presented to the public, e.g. peers, colleagues at work and they expand the intersubjective space.

- *Back to the personal idea*: At the end of the course students take the collective artefact and reflect on the impact of this artefact on their initial and personal idea, which generally has already changed during the collective process.

- *Teachers also build knowledge:* being a model by building knowledge yourself as a teacher in which knowledge building conversation students are free to participate or just watch, might help to get thinking into language and stimulate the transformation process of seeing the world differently.

In addition to the other staff members my fellow teacher Tom van Oeffelt and I used these anchors in our thematic period of 'Visions of learning'. The impact of this on the process of students can best be illustrated by some of their notes. The first one is a nice example of a transformation in the knowledge building process:[30]

"After some frustration reading the English (book: Illeris, 2009b) and having resistance to your tough language[31] I came to appreciate both greatly. By curiosity and eagerness to learn, I have set my teeth into my book and I started together with Ive [a peer student] to read, summarize and exchange the next chapters. But also the Skype-meetings with my knowledge building group and read-

30 With thanks to Mareen van London, MLI student, for permission to use her contribution in KnowledgeForum: July 2, 2015.

31 Marleen responds here to my Knowledge Forum contribution in the conversation with Tom: "Learning to me is an existential, ontological nature which is besides the acquisition of skills, behaviors and cognitions and therein insights, still mainly is expressed in the development of collective and personal insights, ideas: e.g. 'understanding the world .. .. of your human-ness in an ecology of Dasein and beings. These insights, understandings crystallize in conceptual artifacts such as changes in skills, behaviors, cognitions, products, art, culture, etc. "(Frank's idea of learning, 11 Nov 2014).

ing your KF-conversations[32] helped me in testing, enriching, confirming and/or re-shaping my ideas. My frame of reference and insights were being shocked enormously. I have become aware of my now old perspective on learning and a new approach to learning raised (My in use view of learning was actually cognitivist and I said that learning and creating together was important but Now I feel it!). I really had to break off a part of my frame of reference and partly had to rebuild (and so doing, did most hurt!).[33] My vision has shifted from the cognitivist thinking to social constructivism combined with a bit cognitivist. A real shift I made from individual learning to social learning. I am really convinced that learning begins with the social learning and by learning collectively you are learning yourself as well (and you can transform your own frame of reference). Without social learning [collective learning] there is no learning. I could not have come without the others to my perception of learning where I'm now!"[34]

The importance or 'the other' in learning together and being a model as knowledge building teacher is illustrated in the next student contribution. It also shows a nice semiotic process:
"I really need others to understand. By reading your conversation I placed this in my frame of reference and give meaning to it and I respond by starting reflection and I (trans)form my opinion and I give it deeper meaning. A change of my frame of reference is the result (especially to the learning in this theme). According to Kegan informative and transformative learning, because every learning activity contains informative learning!"

"In my view you need cognitive dissonance[35] to learn and to be able to reshape your frame of reference. In our [collective] model of learning we say that there must be stimulus [a sign] to start reflecting – it scours - because there is a tension between the new information / your observations and your own frame of reference. You have the urge to eliminate this tension and the new information or images and your own frame

of reference again to reconcile and perhaps come up with new ideas. So then you give deeper meaning. But for this in my view you need others to find your own unicity".[36]

A reflection of students on the process illustrates 'going from the collective to the individual' and thinking coming into language (culture):
"The moments on the day of meetings, visiting Knowledge Forum and Skype sessions were wonderful moments, where I got the idea that my mind-sets were stretched and deepened. Sometimes I was confirmed that ideas corresponded. Sometimes it was necessary to question on in order to arrive at a shared language, but also in order to arrive at a common direction. Writing in the individual and collective learning and thinking is a handy tool for me. It helps me to collect my thoughts and I can bring them therefore easier to words."[37]

"The way the theme 'Vision on learning' and assignments are offered to me was very teachable. By just starting with the collective process, I grew into a knowledge community (Scardamalia and Bereiter, 2006). By jointly working with knowledge, my own ideas became more and more concrete. It worked motivating and energizing. And it certainly influenced my own choices, because in the end I also appreciated the social dimension of learning as is shown in my own contribution".[38]
"During the conversations with my fellow students, I found that I am able to connect the different theories with each other but that I hereby sometimes proceed too fast and sloppily, for example, "if - then" making claims that are not logical or a text quoting out of context. Cooperation with the group taught me to read carefully and first test my assertions by different parties.'[39]

Another student reflection illustrates the knowledge building going beyond sharing of ideas and from rise above into a conceptual artefact:
"As a group, we shared a great diversity of ideas. We did this at the meetings via the Knowledge Forum and during Skype sessions. By connecting different thoughts and

32 The knowledge building conversation of Tom and myself. Learning together.
33 Transformation, thinking is coming into language and new perspectives to receive and interpreted sings out of the ecology are evolving.
34 Learning together.
35 The cognitive dissonance is actually the interpretation of the signs coming from the ecology not fitting the signs coming from the schemata, memory traces in the cognitive system. The signs from the ecology embed different consequences as in the memory trace, e.g. neurons network connections.

36 See also Biesta, 2006; Heidegger, 1977
37 Thanks to Angelie Broeren van der Spank, MLI student, for permission to use part of her reflection in her assignment product.
38 Thanks to Margriet Bakker, MLI student, for permission to use part of her reflection in her assignment product.
39 Thanks to Erna ter Beek, MLI student, for permission to use part of her reflection in her assignment product   .

refining there began a regular process of 'rise above'. The model with the infinity symbol, for me, was the highlight here".[40]

By reflecting on the experience, we build by participating in some (innovative) practices in pre-, secondary, and higher vocational education I notice that there is an attempt to go beyond consequence learning (Learning 1) and learning new elements (Learning 2). Student agency, learning together) and fostering understanding (Learning 3 are in the focus) to improve education. Starting a curriculum with two beginnings, theory and practice, puts learners in a situation where information, theory (World 3 or 2) and out of practice (World 2) often contradicts and even generates a double bind situation as is expressed in Mareen's writing during the discourse: *'My vision has shifted from the cognitivist thinking to social constructivism combined with a bit cognitivist'.* The 'others' in learning together are necessary ' to find your own unicity' she wrote in one of the Knowledge Forum conversations during the discourse. The deep questioning of the sense and meaning of the information coming from World 1 and 3 into World 2 starts with that "a group, … *share a great diversity of ideas"* and "by *connecting different* thoughts [interpretations of signs, information, thinking coming into language] and *refining* [seeing the difference] *there began a regular process of 'rise above'.*

As Engeström (2009, p58) writes: Learning 3 *is" essentially a collective endeavour".* As Scardamlia & Bereiter (2014, p401) write "*collaborative discourse is the driver for creative knowledge work"* . As Magriet writes: *"Collective learning and thinking (…) helps me to collect my thoughts and I can bring them therefore easier to words".* Knowledge building is a collective semiotic process of going into the meaning of the difference in the theoretical and praxis information and what makes sense for a better praxis. Improving praxis is based on real collective 'Verstehen' (understanding) and transformation of the personal ideas. As Mareen writes: *"Without social learning [collective learning] there is no learning. I could not have come without the others to the point of visioning of learning where I'm now!".*

The role of the teacher is important and not an easy one to identify. Probably it will be a continuous dynamic searching, as we experience in our Master program, be-

cause every knowledge building process is a different semiotic process. Principles, experiences as described above are no more than anchor points drifting in a dynamic learners' eco-semiotic process. As such they are also temporary, conceptual artefacts, by which understanding the difference that might make a difference is made explicit. The studies by Johan, Jantine and also Walsweer are promising in the sense that the process of identifying the role of a teacher is not a matter of following particular teaching behaviour more than we are doing at the moment, but rather of combining what we already doing in response to the knowledge building process of the learners. This means that teaching is probably, just like learning, an eco-semiotic process as well, rather than the carrying out of standard methods. The latter are just drifting anchors.

From the perspective of responsive education for transitional thinking, we can say that this at least starts from interdisciplinarity maybe going into a discourse ending in transdisciplinarity. Spelt (2015) analysed teaching and learning in interdisciplinary thinking in higher education engineering. Her analyses are based on the cognitive by Piagetian influenced model of Illeris (Illeris, 2009). Spelt is pleased by the model and this fit shows that implicitly Spelt's resulting model focusses on World 2 learning (*"understanding how to apply theoretical models"*) she aims *"designing conceptual models representing disciplinary interrelationships"*. I think this could be a step towards transdisciplinary understanding. Spelt describes this learning as doubts, feeling ambiguous, struggling to make sense of the different disciplinary information. According to Spelt 'others' are important in this learning process of a socially engaged learning community of peers and teachers in recognizing similarities understanding different viewpoints by sharing different approaches, arguments and decisions in dealing with World 3 artefacts. Actually we see here a process of learning described that is close to knowledge creation/building.

Knowledge building is therefore a potential approach for responsive education not only in our experience in teacher professionalization, but also in engineering learning together and quality. The studies show that ownership, *agency,* of students in those issues they want to dig deep into and develop their ideas about supports their understanding. If they *learn together* digging into conceptual and authentic issues, their conversations are on how they think differently about scientific and practical ideas. These *'culture of thinking'* conversations lead not only to a deep

understanding of the knowledge they need to know, their *knowledge building* goes beyond the school book knowledge, resulting in a change in the way they look at the world. This appears to be a smooth process, however studies show that students need a good eco-epistemic environment where teachers are enculturated in the discourse of knowledge building and scaffolding students in the regulation of their learning together and knowledge conversations. The development of environments such as Knowledge Forum and learning analytics may be supportive.

Developments and research

Knowledge Forum

Knowledge building is possible in every learning situation: face to face or in virtual forums. The problem with face-to-face situations is that the thoughts, the conversations evaporate in the air and distribute in the various minds. Afterwards you are unable to grasp the thoughts, they are difficult to build on. That is why we use Knowledge Forum. Knowledge Forum is an educational software designed to help and support knowledge building communities. Knowledge Forum is an asynchronous computer mediated communication (CMC) technology that provides a shared

discourse environment. It facilitates collaborative knowledge-building strategies, textual and graphical representation of ideas, reorganization of knowledge artefacts, provide scaffolds (My theory; I need to understand; New Information, etc.) and diagnostic tools (network analysis, quantitative contribution analysis, etc.).
The product is used in a large variety of kindergartens, primary and secondary education establishments, universities, work organizations, teacher professionalization programmes in 19 countries in the Americas, Europe, Asia, Australia and New Zealand. The Institute for Knowledge Innovation and Technology (IKIT) from OISE is the research group that has taken charge of future developments of Knowledge Forum. Knowledge Building International (KBI) community, a not-for-profit membership-based corporation, with the intention to serve the knowledge building community of innovators and researchers, and dedicated to advancing research, practice and public awareness of knowledge building, is currently participating more and more in the development.
In Knowledge Forum every contributed thought is an artefact on which yourself and others can build, annotate, refer, and rise above. This means that you can go back
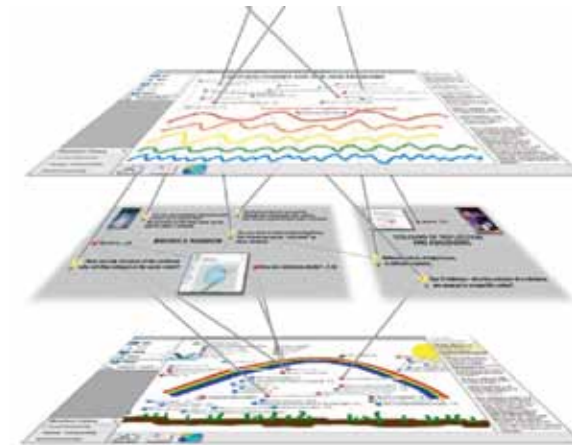

Figure 26. Rise-above graphical user interface for the next generation knowledge building technology, like Knowledge Forum which visualizes the rising to a higher level of understanding (Scardamlia & Bereiter, 2014).

to knowledge conversations you had. The support and aids to students and other learners in (re)constructing and improving ideas at a progressive higher understanding level is facilitated by rise above as a visual metaphor that visualizes the rising to a higher level of explanatory coherence and understanding (see fig. 26).

KF Research

In the project we intend to use Knowledge Forum to support responsive educational process. Our intention is to carry out design based research together with the relevant schools, companies and researchers and explore the development of video integrated knowledge building to bridge and support knowledge building conversation between students' real-life(knowledge) experiences and the knowledge building discourse in responsive education. We intend to do this in cooperation with 1) Cattaneo's video mobile phone/camera based learning research;[41]
2) Knowledge building community: Jan van Aalst[42] and Marlene Scardamalia.[43]
The Webbased VIB of IRIS Connect will be researched as a support for the teacher

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41 Swiss Federal Institute for Vocational Education and Training (SFIV)
42 Hong Kong University, China
43 Toronto University, Canada

professional learning community in the context of responsive education. Coopera-
tion will be set up with IRIS-connect video-based classroom based observational
learning[44] ; We can build on experience with professional learning communities in
the project 'Professional Learning Communities' from the Ministry of Education,
Culture and Science[45] and our professional development in the HPBO project
'Assessing for Learning' (Evalueren om te leren Slot et al., 2015).[46]

(Semantic) Learning analytics (LA)

The advantage of working with a CMC environment is not only that you can go back
in to the conversation any time anywhere, but also that it makes it much easier to
research the thought and knowledge building processes as they are available in
the database. In the Responsive Education project the intended research involves
responsive learning supported by learning analytics. Learning analytics are tools
added to digital learning environments to gather, analyse student data and present
this in summaries and visualisations to support teachers or student learning. Re-
search by Leeuwen (2015) shows that LA supports teachers to monitor students
and their adequateness in intervention to student needs. In many studies LA fo-
cuses on frequencies of participation, contributions, amount of readings, referenc-
es, etc. In the project Responsive education, we are in particular interested in car-
rying out research with so called semantic analytics. Discourse analysis is widely
used in a range of academic subjects, all concerned with how humans make mean-
ing and communicate within and across different social and cultural groups. The
research has to shed light on the one hand to obtain a better understanding of the
semiotic meaning making processes and on the other hand to see in what way
these learning analytics can be a support for teachers' activities (Leeuwen, 2015)
and students' knowledge building in their discourses (Matsuzawa, Oshima, Oshi-
ma, & Sakai, 2012). The knowledge building Discourse Explorer (KBDeX)[47] is such
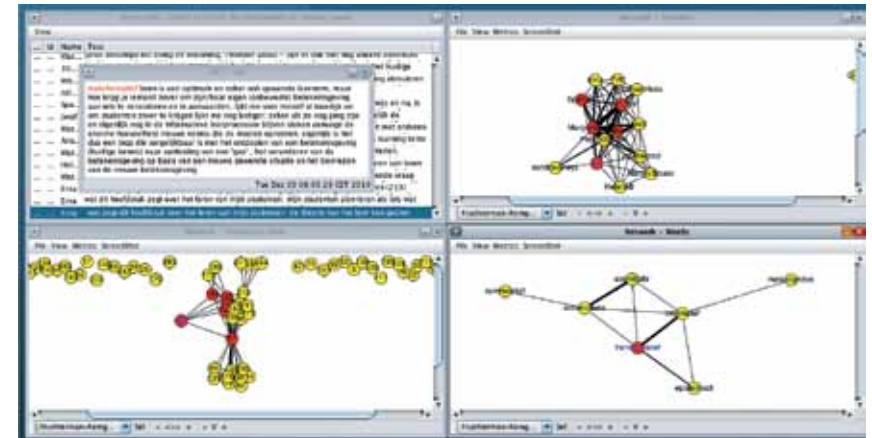a semantic LA (Matsuzawa, Oshima, Oshima, Niihara, & Sakai, 2011). Sayaka,

*Figure 27: KBDeX analysis of the discourse of Tom and myself and the students. Left upper:
Discourse corner; Upper right: the learners network structure sharing at least one selected
key word; left down: a network structure of notes based on the co-occurrence of selected
key words; and right under: a network structure of selected key words based on
co-occurrence within same notes.*

Matsuzawa, & Shirouzu, (2014) study shows that when students used a LA
(KBDeX) in the analysis process about constructive interaction, their beliefs on the
effects of collaborative learning changed. KBDeX is a methodology for discourse
analysis in collaborative learning from the perspective of complex network science.
Network structures of discourse are visualized based on a bipartite graph of words
× discourse units (e.g. conversation turns or sentences). In Fig. 27 network struc-
tures of the discourse Tom and myself where involved in illustrates: (1) Input con-
cerns discourse data (a text file in .csv format) and a list of target words for bipar-
tite graph creation; (2) the learners' network structure; (3) the unit network
structure; and (4) the network structure of target words (Sayaka et al., 2014).

The next generation as presented during the Learning Analytic week at Wagenin-
gen December 2015[48] will give feedback and insight to students on the semantic

44 http://www.irisconnect.co.uk
45 Education Executive Agency: Ministry of Education, Culture and Science. https://duo.nl/zakelijk/ho/
     bekostiging/maatwerk_muo/professionele_leergemeenschappen.asp ; Twente University: https://
     sites.google.com/site/projectplgs/
46 www.kracht-van-beoordelen.nl (retrieved October 2015)
47 http://www.kbdex.net/index.html

48 'Knowledge Building Advanced Learning Analytics Study –Colloquium/Hackathon/Design Jam–
     meeting' December 15-19, 2014 at Stoas Wageningen | Vilentum Applied University, The
     Netherlands.

strength and connection between persons in a group as Matsuzawa presented at the end of the first International 'Knowledge Building Learning Analytics Hackathon/Design –meeting' at Stoas Vilentum Wageningen (see fig 28).
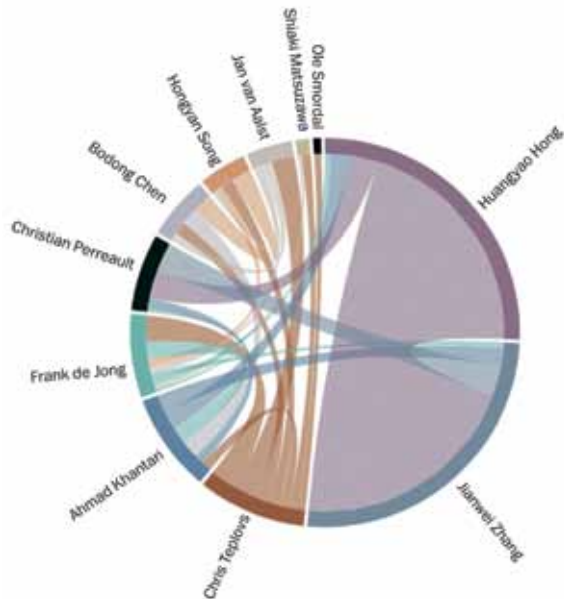
Figure 28: The semantic connection between some participants of the 'Knowledge Building Learning Analytics Hackathon /Design –meeting' based on conversations in Knowledge Forum as presented by Yoshiaki Matsuzawa and Chris Teplov at the end of the meeting.

Another semantic learning analytic concerns the alignment of student writings and curriculum content, e.g. literature to read. These analytics are based on similarity measures (Velazquez-Godinez, Ratté, & Desrosiers, 2014). We collaborated in a pilot study with Erick Velazquez-Godinez and Sylvie Ratté[49] concerning the similarity between the literature students had to read for the thematic discourse 'visons on learning' in our Master program and the final papers for their assessment. The results were presented at the first International 'Knowledge Building Learning Ana-

49 From the Laboratoire d'ingénierie Cognitive et Sémantique (LiNCS), Département de génie logiciel et des TI, École de technologie supérieure, at Montreal Canada.
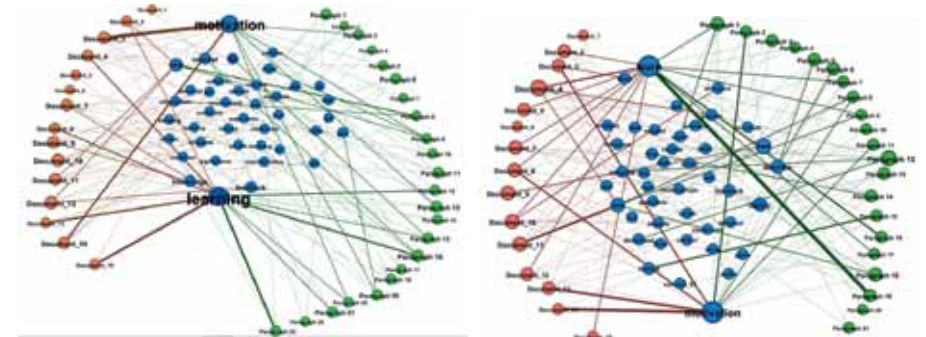

Figure 29: The left graph represents the student A his paper by which he fail to pass the assessment and on the right hand the graph represents his revised paper by which the student passed the examination later on. Red dots: each dot represents one literature document in the curriculum. Blue dots: representing words with highest similarity between literature and student's term paper. Green dots: paragraphs in the student's term paper. The thicker the connection lines the more frequent the term is used.

Figure 30 represents the term papers of two other students in the discourse. You can see how the literature is elaborated in the papers and the volume of similarity of words. These kinds of semantic analysis probably can also be used in the future to analyse the discourse itself and give student insight into how they give meaning to the information coming from the literature, but if written down in text also from the practice. This brings us a step closer to analysis and insight in the semiotic process of the knowledge building discourse in responsive education.
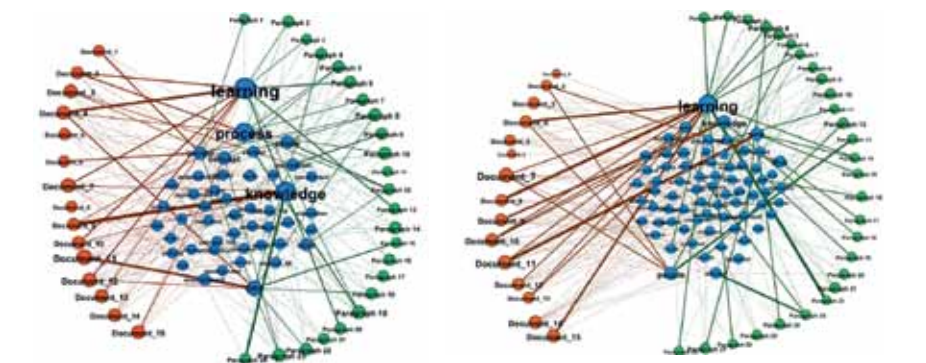
Figure 31: Two other examples of similarity between curriculum literature and student B and C term papers.

lytics Hackathon/Design –meeting' (Velazquez-Godinez & Ratté, 2014).[50] In figure 29 you see words in blue circles that have the maximal semantic value between the literature to be studied (each red dot is 1 document) and the text of the student's paper (each green dot is one paragraph). These words help to interpret how similar the vocabulary of a student is regarding the vocabulary from the curriculum literature. The graphs are from the same student. The left graph shows that the words 'learn' and 'motivation' are the most used concepts. It also shows that Motivation is mainly used in the first sections and Learn in the last sections. There seems no coherent use of terms in the first and last part of the paper. Also you see that in the first paper less literature is used and there is less similarity in the vocabulary used than in the right graph. The left graph represents the student's paper by which he fails to pass the assessment and on the right hand the graph represents the revised paper by which the student passed the examination later on.

Learning analytic Research

In cooperation with the Japanese groups of Matsuzawa[51][52], and Oshima, we want to study the use of (semantic) LA as a support for teacher and students related to embedded assessment for learning (AfL) in responsive education.

According to a review by Van Benthum, (2013)[53], one of our teacher-researchers, three main processes of AfL can be identified for teachers, students and peers important for AfL: 1) identifying where learners are going; 2) where they are in their learning and 3) how to get there. (Benthum, Gulikers, Jong, & Mulder, 2013). We can build on this research, but also on the ongoing research of teacher-PhD-research Hennie van Heijst.

The analytic framework developed by Hennie in which the students' open or close mindedness as represented in their cognitive and social presence in the knowledge creation conversations helps us to obtain insight into the student mind-set and their knowledge creation process (Heijst & De Jong, 2014). The ongoing cooperation with Jin Mu and Jan van Aalst (University of Hongkong) concerning automatic coding of questioning patterns in Knowledge building discourse will also be built on (Mu, Stegmann, Mayfield, Rosé, & Fischer, 2012).

Cooperation will also be sought with other learning analytic developers within the knowledge building community such as the 'idea thread mapper' (Zhang et al., 2014) and others (Chen & Chen, 2015)[54], Sacardamalia[55] .
It is obvious that we also intend to continue the cooperation with the Ratté, Velazquez-Godinez group[56] concerning the similarity analyses between literature and students' conceptual artefacts such as term papers.

The project Responsive Education

As mentioned previously, the project Responsive Education is part of and connected to 4 other design and research professoriates in the domain of transition for the food and agriculture sector.

In part I, we have seen that emergent environmental issues do not stand alone and are deeply rooted in our western culture of thinking. This results in a double bind situation because we owe a lot of our current prosperity and wellbeing to this way of thinking. The downside is a myth that science and technology is getting more grip on the ecology and everything seems feasible in our theorizing and the world can be man made, simultaneously alienating us from our ecology.
This may be a reason why the other side of the coin is not so easily coming into language. Namely that many solutions implicitly are also the cause of the serious threats in our ecology. Because of the link with our thinking, the environmental

50 'Knowledge Building Advanced Learning Analytics Study Colloquium/Hackathon/Design Jam –meeting' December 15-19, 2014 at Stoas Wageningen | Vilentum Applied University, The Netherlands.
51 Aoyama Gakuin University, Department of Social Informatics; Japan
52 Shizuoka University, Faculty of Informatics; Japan
53 www.kracht-van-beoordelen.nl (retrieved 2015)

54 University of Minnesota, USA
55 University of Toronto, Canada
56 École de technologie supérieure in Montreal, Canada

threat is also a cultural issue and by saying so an educational issue because that is an important space where our thinking is educated. A place where we often are socialized to take for granted many of the conceptual underpinnings in our daily and scientific thinking. This underpinning actually has to come more into language anywhere and any place where we experience a need to learn, understand and build knowledge.

An ecological intelligent way of thinking is worth thinking about. What Bateson called an elementary idea or bit of information, the "difference which makes a difference" is always part of a pattern of thinking, of a system of connections, of an eco-semiotic process leading to a life-sustaining process. Eco-system thinking is where analyses of the pattern (relationships) and structure (temporary components) of organisation activity systems has to identify which difference in a pattern or structure of components produces a transformation of other components in the ecology (Bowers, 2010). Ecological intelligent thinking also includes understanding the history and diversity of influences in our thinking and actions (Bowers, 2010).

In part II, we have reinterpreted learning, guided by Bateson's levels of learning and looking at
1. Eco-semiotics: r*eciprocal interpretation process*
2. Others
3. Thinking the past
4. Epistemological development

Looking at learning from an eco-semiotic perspective sheds new light on the potential several manifests of learning have for transition, as is claimed in the mentioned professoriates' projects on concerning transition in food and agriculture. All manifests of learning are needed in life. However, if 'social interactive learning' and in particular in the form of knowledge building, is not present in education, society is missing an opportunity to educate students for an ecological thinking and a sustainable culture and life.

From part II the basic ideas for responsive education e.g. agency, culture, learning together and knowledge building, are put forward in part III. Experiences from some of our teacher-research studies, educational practice and other activities, illustrate these ideas, leading to several pedagogical anchor points. It also leads to the following research lines in the Responsive Education project.

1. *Transitional thinking:* Analyses of patterns, structures in the kind of thinking and levels imply the transition like result of the casuistry, pilots in other projects. What are the cross-overs? What are the differences with the 'old thinking'? What information, underpinnings and understanding leads to what kind of action in the other projects? What kind of learning is related?
   This will take place in crossover groups meetings and by the use of knowledge forum in the period between meetings. This will result in a model of the demands that transition puts on education.
2. *Responsive learning environment*: Design-based, developmental work research to foster agency, culture, learning together and knowledge building in the responsive education practice. Research into the constructive use of modern educational tools such as web supported video, mobile phone, knowledge forum to support the responsive learning of students. The research is done in research-practice- partnerships in teachers' professional learning communities.
   This will result in responsive learning environments in participating schools and professional development of the teachers, researchers, etc. involved.
3. *Learning analytics:* a) Analysis of knowledge building processes to generate insights for research line 2. b) Exploring the supportive impact and use of learning analytics for learning and teachers. c) Exploring the possibility of embedded assessment for learning these tools. Even more than in research line 2, we need the international cooperation of other research groups in this area.
   This will result in strong supportive tools for learners and teachers to realize a responsive discourse.

By its research the Responsive Education professoriate project aims to shed light on how education can equip students to meet future emergent, complex and often ill-defined issues in a changing society and industry. it is obvious, therefore, that responsive education lays the basis for transition, since the seeds of learning to think and, by extension, transition thinking, are fed into education Responsive education is the place where we learn to think in a way that enables us to make decisions with the awareness that acting as result of our thinking has an impact on all corners of our biosphere and the conditions of our common, global future physically and culturally (Van de Gronden, 2015). In this document I was looking for what would make the difference for this kind of education. I have found that 'starting

from three beginnings': theory, the practice and bringing into language the embedded thinking, by bringing them into a knowledge building discourse has potential for responsive education. Responsive education is a world of difference.

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57 Dutch: Lectoraat Responsief Onderwijs

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APPENDIX A
Summarization of the different manifests of learning

Manifests of learning	concepts	ecosemiotic	other	The past thinking	Epistemic development	Future. Transitional potential
Zero '0' learning **interpreting specific signals out the environment and a compiled relational response in principle not subject for change.**	Habituation, sensitization, reflexive learning, cumulative learning, mechanical learning	Interpreting signals at a compiled relational semi awareness level; difference lead to more or less of the same behaviour	Individual interpretation process	Memory trace build on previous experience is the active	Habit; the epistemological development is zero, now new knowledge is learned. *World 1 practice*	Habit development, conservative. Slow, minimal, evolutionary change.
Learning 1 functioning of the circuit of mind-set-action, feedback - differences- and correction within a set of alternatives.	Classical and operant conditioning, rote learning, prototype learning	Interpreting signals and difference in balancing states of body and mind and pre-set consequences	The environment influences the pre=set state, choices that can be made and related consequence. Individual but cultural loaded process.	Not explicitly focused, implicitly active in the external influenced mind setting, choices offered.	'mind set–action-consequence' (if-than) relational way of thinking *World 1 learning in practice*	Faster learning and change but the treat of extinction if consequences change.

Manifests of learning	concepts	ecosemiotic	other	The past thinking	Epistemic development	Future. Transitional potential
Learning 2 Change in the set of alternatives from which choice is made, or it is a change in how the sequence of experience is punctuated.	Piagets' concepts of assimilation and accommodation	signals (evidence, facts) constructive reciprocal interactive meaning making in the expanding or reconstructing of knowledge schemes and patterns	Others function as sources of new information.	The way of thinking is not in play, only new information. So 'past thinking' stays in mostly in tact.	Assimilation: Reproduction of knowledge from other domains or practice, Extending or rebuilding and widening of knowledge in the existing process of thinking. 'The map is not the territory'. Cognitions, Idea maps as a reality *World 2 (school) cognitive (school) learning by the student)*	Cross boundary of evidence, "new information' is a first openness, first step to transition especially in case of accommodation. Expanding alternatives in existing thinking
Learning 3 Social learning; form of meaning forming Change in the process of learning towards social and collective learning, change in the form of meaning making.	Modelling and cooperative learning	Interpreting the information is a cumulative dialogue of individual interpretation processes. Group communication becomes learning.	Social culturalism. Using each other to understand what is known in a dialogue where social and cultural experiences are coming together.	The 'old thinking' in theories stays mostly unrevealed, because of the strong focus on the world 2 learning tasks).	Concerns mainly the reproduction of existing knowledge. Enabling of individual cognition. Communication, exchange of interpretations, becomes a source of knowledge. *World 2 (school) learning by students enabled by social interactions.*	Communication becomes an explicit source and sharing of different views on the world. This community building and positive interdependence are a basis for getting to see relations.

Manifests of learning	concepts	ecosemiotic	other	The past thinking	Epistemic development	Future. Transitional potential
Learning 3 Social learning; form of meaning forming Change in the process of learning towards social and collective learning, change in the form of meaning making. (Cont.)	Collaborative learning Social interaction focusing on the development of common ground and shared knowledge	Social Interactional Negotiation, sharing of meaning. Information interpretation takes place at individual and group level.	Groups of people are a major source of a dialectical knowledge co-construction dialectical dialogue.	Revealing the 'old thinking' in theories is a by-product as it reveals itself in the difference between the ideas of the different subjects (world 2) and their experiences (world 1)	Group cognition, common ground and man-made character of knowledge artefacts representing a shared group negotiation result. World 1, 2 (the collaborative learning task, subjective ideas and experiences) and incidental world 3 (world of scientific reasoning and conceptual artefacts)	Getting skilled in negotiating knowledge and experiences, finding the common ground and construction group cognition supports a multidisciplinary approach. Learning is not only individual but also an indispensable group process.
	Knowledge building; Progressive inquiry learning, expanded learning, Trialogical learning, Transformative learning.	A knowledge building conversation in which an engaged going into the conceptual artefact to receive the embedded signs and codes, the artefacts go into the minds generating new common ground for 'Verstehen'.	In the 'knowledge-building-conversation' is it not a merely against each other and putting your own positions, but a transformation into the common, into the collective. A transformation in which one does not stay, who one was.	'old thinking' is revealed in its inclusive principles and higher problem formulations into new syntheses. Partners in the conversation," knowledge builders, transcend trivialities, oversimplifications and move beyond current practice.	Collective understanding of the difference that come into language, rising above to a new common ground, generating new conceptual artefacts. Enculturation in the scientific thinking starting from the subjective ideas in world 2 and exploring difference from two sources World 1 and world 3.	World 3, 2 and 1 are connected in the conversation by going into the conceptual artefact always related to praxis, leading by the difference to create new ground for innovative praxis and concepts, improving ideas, transformative and transition directed.

Manifests of learning	concepts	ecosemiotic	other	The past thinking	Epistemic development	Future. Transitional potential
Learning 4 New constitutions of perceiving signals	Biomimicri; Technology; Other sensory modi	?	?	?	?	?

APPENDIX B
Overview KB principles (Scardamalia, Bereiter, 2002), coaching interventions and didactical arts (Jong et al., 2009)

Many of the didactical arts can be read more about in many handbooks. The selected didactical arts can be used to enhance the knowledge creation process. This is because the focus is on the mentioned Knowledge building principles. Knowledge development and creation is central in contrast to knowledge reproduction. Many of the didactical arts described below can be used in relation to more than one principle. However, the use of certain didactical arts may impact on the realization of more principles.

KB- principles (Scardamalia, 2002)	Coaching interventions (remarks that can be made and attitudes)	Possible didactic arts
1. *Real ideas, authentic problems* Knowledge problems develop from trying to understand yourself and the World around you. Ideas are as tangible as objects. It are the students own ideas that they really care about them instead of the regular text book problems.	- Is it your own idea? - What does this subject mean for yourself? - Where do you come across this idea? - Do you know people or situations where this happens? - What is interesting and in for you?	- post-its with associations (brainstorms) in relation to the subject - word web - context description in which ideas appear - brainstorm - collage - demonstration, visual instruction - wall poster clustered in relation to ideas and themes - white board association - inner/outside circle (fish bowl)
2. Ideas are improvable All ideas are approached as improvable. Students work constantly to improve, quality, coherence and utility of their ideas. An emotional and cognitive safe atmosphere is necessary to realize this. An atmosphere where one can make mistakes, can have incomplete ideas, may not know something, is positive and feels free to receive and give compliments, feedback, critics and feed forward.	Improvable: - Does it come up to your expectations? If not … - What is the usability? - It can be better, because … - This is related to… Safe atmosphere: - A different opinion or idea is appreciated as starting point of improvement - We are here to learn and create together.	- forum- of panel discussion - giving and receiving feedback exercises - alter-ego method / fish bowl/ inner outer circle - Socratic method

KB- principles (Scardamalia, 2002)	Coaching interventions (remarks that can be made and attitudes)	Possible didactic arts
3. Idea diversity Idea-diversity is essential for the development of knowledge. Just as biodiversity is essential to the success of an Ecosystem. In order to understand an idea you have to understand the related ideas even does who are in contrast with it. Idea-diversity creates a rich environment to develop ideas in to more elaborated, new and refined ways.	- The more opinions differ the - What objections are there? - Where does this and does not appear this? - Is this always have been so? - So the opposite is not true? - What does has to do with it?	- Search for different opinions (Google, Wikipedia, arts, cartoons) - Create a drawing, model, movie, picture etc. of the opposite thinking? - Invited a controversial guest speaker - Opinion discussion carousel discussion; position play - Case method - (Critical) Incident method - Public interview - 'What would happen if…' play.
4. rise above Creative knowledge creation, entails working toward more inclusive principles and higher-level formulations of problems. It means learning to work with diversity, complexity and messiness, and out of that achieve new syntheses. By moving to higher planes of understanding knowledge builders transcend trivialities and oversimplifications and move beyond current best practices.	- What is the common denominator of all these ideas? - What is the thread, the leitmotiv of this subject? - Who, what, where is this explained?	- Conclusion or position discussion - Create a name for the 'umbrella' - What do the ideas have in common (convergent)? - Construct a covering model' - make a cartoon which covers and makes the essence transparent. - exposition - building a wall - what is the 'bottom iceberg' (the underlying principles) - 3 (or 5) times "why ?"
5. epistemic agency Students set forth their ideas and negotiate a fit between personal ideas and ideas of others, using contrasts to spark and sustain knowledge advancement rather than depending on others to chart that course for them. They deal with problems of goals, motivation, evaluation, and long-range planning that are normally left to teachers or managers.	- How are you going to set this on work? - What is the aim of the project? - How do your different interests fit together? - Make a plan for this project. - Motivate yourself and the others. - Make agreement in case the process does not run very well.	- plan of approach, individual and group - Group contract/rules about collaboration and support. - Learning contract method - Priority game
6. community knowledge, collective responsibility Individual and team performances are appreciated equally. Team members produce ideas of value to others and share responsibility for the overall advancement of knowledge in the community.	- Take care that the individual and the group contributions manifests itself in the appraisals and assessments. - You are also responsible for the learning of the other students	- Group contract/rules about collaboration and support - Create / use an instrument for individual and group assessment - Use KF-tools - Organize excursions - Dialogue with open chair - Roll play: play a groups incident talk about the solution

KB- principles (Scardamalia, 2002)	Coaching interventions (remarks that can be made and attitudes)	Possible didactic arts
7. democratizing knowledge All students are legitimate contributors to the shared goals of the community; all take pride in knowledge advances achieved by the group. The diversity and divisional differences represented in any organization do not lead to separations along knowledge have/have-not or innovator/non-innovator lines. All are empowered to engage in knowledge innovation.	- Every idea, of everyone, are equally important - Coach the students who efface themselves, who do not or less who dodge themselves - Use the KF-tools to monitor the process	- use KF-tools
8. Bringing knowledge is getting knowledge; symmetric knowledge advancement. Expertise is distributed within and between communities. Broadening and deepening one's outlook happens by sharing your development with others and let them think with you as well as using experts.	- Convince students of the valuable and usefulness of their work - Phrase and let them phrase what is special in their ideas, activities etc.	- Reflection on intermediate products by external persons (workplace coaches; other teachers, experts, friends, others, your mother in law etc.) - Invite other groups - Presenting to other groups, in other contexts - Guest lectures / workshops - Dialogue with experts the dilemma's - Organize a chat box about the topic and invite others to join the chat - Expert groups (puzzle method)
9. pervasive knowledge building Knowledge building is not confined to particular occasions or subjects but pervades mental life—in and out of school.	- Coming to understand takes places everywhere.	- Search for other possibilities, situations which facilitate knowledge creation (projects, museum, galleries, workplaces societies, clubs, content, theatre etc.)
10. constructive uses of authoritative sources To know a discipline is to be in touch with the present state and growing edge of knowledge in the field. This requires respect and understanding of authoritative sources, combined with a critical stance toward them.	- Who or what authoritative source can you (book, person, site)? - Think critical, formulate a critique	- Formulate critical statements about authoritative sources. - Panel discussion between 2 or more panels who studied controversial sources - interview an expert - Lecture en discussion - PowerPoint; present - Excursion to a prominent context - film / video - study literature

KB- principles (Scardamalia, 2002)	Coaching interventions (remarks that can be made and attitudes)	Possible didactic arts
11. knowledge building discourse The discourse of knowledge building communities results in more than the sharing of knowledge; the knowledge itself is refined and trans-formed through the discursive practices of the community— practices that have the advancement of knowledge as their explicit goal.	- Dialogue don't discus (yes and .., instead off yes, but….. - Respect somebody else opinion and build on….	- Intervision - Dialogue - Temporary injunction (discussion) - A Lower House (debate) - Problem solving dialogue and variations: value explaining dia-logue, a case critical incident dialogue, conversation diagram, snowball group, Match conver-sation; elevator talk. - Fish bowl method
12. embedded and transformative assessment Assessment is part of the effort to advance knowledge it is used to identify problems as the work proceeds and is embedded in the day-to-day workings of the organization. The community engages in its own internal assessment, which is both more fine-tuned and rigorous than external assessment, and serves to ensure that the community's work will exceed the expecta-tions of external assessors	- what makes this product/project excellent, e.g. better than another? - Compare this with regular testing and assessment	- Describe your own assessment criteria for the product/project - Assess each other and the group - Exposition - Poster presentation - Product/project market