

## A FRAMEWORK FOR ENTRE- PRENEURIAL LEARNING IN HIGHER EDUCATION

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*A framework for entrepreneurial learning in higher education*

**Abstract:** This paper is a conceptual paper that develops a framework for how to provide an entrepreneurial learning environment in higher education. The framework is based on Vygotsky's pedagogics and Polanyi's concept "tacit knowing". The teacher will instruct the students on how to do "things", getting experience of how to do things they cannot yet do, proposing methods how to externalise and reflect on the tacit knowing, in order to acquire a reflected externalised knowledge.

**Keywords:** Entrepreneurial Learning, Concept Maps, Tacit Knowing, Zone of Proximal Development. Expanding Learning Environment



## 1. Problematisation

This article proposes to build an entrepreneurial learning environment for future business professionals, based on a better *knowledge about requirements*, a *pedagogic ethos*, and the economic necessity to build *structural capital* in higher education in spite of the lack of resources to do so.

Professional academic education has to comply with many demands; students needing a basis for life-long learning and the ability to change their life trajectory, a professional community with a requirement of productive workers, a faculty that requires the students to get a certain level of understanding of one or several social science subjects, and social science methodology. This paper proposes how to build such educations, based on *community based concept maps*, a *Vygotskian pedagogics*, and Polyani's concept "*tacit knowing*".

Running higher education typically involves a cost structure with 60-65% salaries, 20-25% fixed costs, mainly buildings, and some 10% in expenses. ("... 80 procent av universitetens kostnader är utgifter för personal och hyror." (Finish Parliament, 2015-12-05)). The high share of salaries and almost non-existing productivity increase, the *relative* cost of higher education increases as the productivity in other product and services increases. An increasing share of the population also need higher education. Thus, the total costs for society has radically increased. In an effort to economise with limited resources most western countries have radically differentiated the financing of technical and medical education on the one hand, and social science and humanities on the other. The situation for social science education has become increasingly strained. Social science professors hope to influence the state to increase the founding (UNT, 2013-10-26; HSV, 2013-10-26), but so far unsuccessfully.

We have taken initiative to develop, implement, and during five years manage two bachelor and one master (one- and two-year) programs in marketing. We also participated in a self-evaluation of these in the summer of 2011, which was part of the requirement of The Swedish National Agency for Higher Education, now The Swedish Higher Education Authority. The programs were based on a very clear idea of subject-progression. The self-evaluation provoked a revision to improve



the methodological progression of the programs. But it was evident that these changes were not enough.

From this background we face four problems that motivate the need for entrepreneurial learning in higher education:

- Very complex requirements from stakeholders.
- Limited resources; the need to become more efficient.
- Low quality of present education.
- The need to build structural capital to become more efficient.

To deal with these problems we assume some core ideas:

- It is necessary to strengthen the integrity of the programs.
- To make higher education more efficient we have to build structural capital.

Based on a 'Vygotskian' view on pedagogics, it is necessary that:

- The program is broken down to courses and then to *moments of proximal development* that are gradually widening during the program.
- To develop methods to identify *each individual student's 'zone of proximal development'*, which is both possible for the student to span, and which is challenging enough.
- To develop the 'caring' aspects of the teacher – student relation.

In the following text we develop our views concerning these problems, and explain why we have chosen these core ideas.

The first part deals with the complex requirements on higher education. Concept maps are introduced as a tool for understanding and manage this complexity. This part explains why we focus on structural capital.

The second part deals with the pedagogic foundations of the project. In this part we explain the methods we want to use to strengthen the quality in higher education. 'The zone of proximal development' is used to explain how entrepreneurial learning can be achieved in higher education, and why we focus on the relation-



ship between student and teacher. Polanyi's concept "tacit knowing" is introduced and the consequences for our subject is drawn.

The last part deals with thoughts about how we can build and use structural capital in higher education to make education more efficient and give students more time with teachers.

## 2. The complex requirements on professional higher education

To clarify the complex requirements on higher education we use the idea of 'concept maps'. Concept mapping, developed by Novak, 1990, 1996, 1998, has been shown to be a classroom technique that can enhance learning in the sciences. It can be a helpful metacognitive tool, promoting understanding in which new material interacts with the students' existing cognitive structure. The interaction of new and existing knowledge is made easier, if the existing knowledge is made explicit to both teacher and student. To understand a concept entails having an internal representation or mental model that reflects the structure of that concept. A concept map is an attempt to make explicit such a model, so that it can be reviewed with others and oneself! (Kinchin, Hay & Adams, 2000:44).

Halford (1993:23, after Kinchin, Hay, & Adams, 2000:44) proposed that mental models may consist of any combination of propositional and imaginal representations. A concept map can, therefore, be seen as a portrayal of a mental model. (Kinchin, Hay & Adams, 2000:44). Curriculum documents and schemes of work need to concentrate on links between concepts, as much as on the concepts themselves, as without appropriate links the concepts lose meaning. (Kinchin, Hay & Adams, 2000:50) Concept mapping, also called semantic networking, whereby the learner draws a diagram indicating the concepts that make up an area of knowledge and the way that these concepts relate to each other, has long been advocated as an effective metacognitive strategy. (Fisher, 1992; Gaines and Shaw, 1995, both after Dalgarno, 2001:189; Kinchin, Hay, & Adams,, 2000:50).

Concept maps are field theories. Each individual concept can be problematised, and for each concept map there are competing concept maps in a universe of field theories. Although each such concept map can be highly complex, the complexity

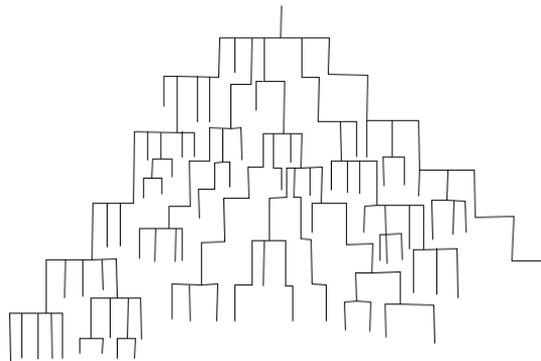


is multiplied by its interrelations, with embeddedness in other concept maps. This embeddedness can be seen as hypertext relations between concept maps, akin to the synapses in the human brain.

Hypertext has been advocated as a mechanism for applying cognitive flexibility theory, a theory that focuses on advance knowledge acquisition in ill-structured or complex domains. (Spiro et al., 1991, after Dalgarno, 2001:186). The node-link structure of hypermedia environments has been compared with the way information is stored in the brain. (Warren, 1989, after Dalgarno, 2001:189).

## 2.1 The Intellectual product structure

To use an industry analogy, concept maps can be said to be the 'product structures' of knowledge production. They show how a concept consists on lower order concepts in a complex structure to 'build' the field. The hierarchical relations show the elements necessary to understand an element of higher order, making it possible to sub-divide the field in modules, 'chunks' of interdependent knowledge



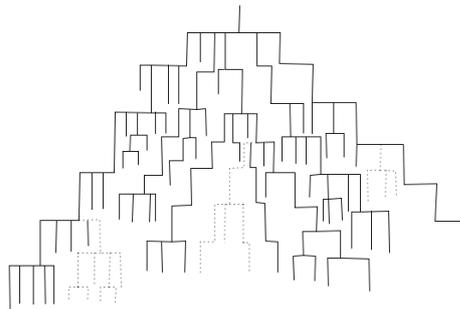
**Image 1. The concept map, the intellectual product structure, own.**

An example are the relations between satisfaction, word-of-mouth, and company reputation as antecedents of repurchase and loyalty. It means that the previous three could be part of a problematisation of the former, and that an understanding of the former probably should probably be preceded by the former.

## 2.2 The virtual intellectual product structure

Just as for most industrial products, university education must be adaptable, in order to fit different needs and to allow for economics of scale. In the virtual product structure the product can be adapted to customer needs by changing components or modules of the product structure. In industry this is usually called standard-special products, or make-to-order. This can be very complex, because of dependencies between parts of the structure; if one module is changed other parts of the structure might need to change. In the early 1990s we designed a system for Asea Brown-Boveri, ABB, for closing virtual products for complex machines without re-engineering, involving some 5000 articles in a nine-level product structure.

In the case of an academic professional education the virtual product strategy would be used to permit students to take different learning paths to partly different orientations within the same encompassing education.



**Image 2. The virtual concept map, own.**

Not only, and rather trivially, can different courses be used in several programs, but more importantly for building flexibility and economics of scale "chunks of knowledge", as small as a standard lecture could be used in several courses. This might seem trivial, but in order to be part of a make-to-order educational environment not only the learning goals of this chunk has to be described, but also the learning prerequisites. Then it becomes part of a library of lectures that can be used in a virtual knowledge structure, where in order to use this specific lecture, it must be preceded by other lectures and learning elements necessary to fulfil its



prerequisites. If well-defined knowledge-components reside in a database it can be used to produce a make-to-order education in a short time-frame.

### 2.3 Academic education

Academic education is determined by *one subject field concept map*, in our case business administration, and a *social science methodology concept map*. An education will give the environment for learning a certain complexity of such a concept map over time.

### 2.4 Professional education

Professional education is the concept map of the *application skills* necessary to be a professional in a community of practice. The concept map of this community of practice differ from that of the academic field that studies the community of practice, in the sense that the academic field tries to understand the community of practice, while the community of practice needs future-oriented guidelines for what to do; it is the application of scientific "laws" in a particular situation and is hence an "art", and not a science, cf Heidegger (1954:19) on science: "Being does not become accessible like *a* [my emphasis] being. We do not simply find it in front of us. As is to be shown, it must always be brought to view in a free projection."

The medical practitioner uses the science of medicine to try to find remedies of the individual problems of a patient. "Because the purpose of the learning is for neophytes is to develop into bona fide members of a community of practice, the behaviours that are performed should be authentic, that is, they should match those expected of practicing members of the community (Collins et al., 1989, after Borthick et al., 2003:113).

Furthermore, situating the learning in the community of practice that the learners seek to enter has the advantage of promoting the learners' sense of identity with the community, rather than with the passivity of just learning for the school. Learning becomes a progressive process of attempting more and more challenging understanding performances that gradually expand the learners' capabilities. (Perkins & Unger, 1999:97, after Borthick et al., 2003:113). To create the concept



map of a professional education, expert practitioners in the field must be consulted to build the concept map of necessary skills that a future member of the profession must possess. "Rather than being situated in practice, traditional educational materials are often intentionally de-contextualised on the premise that the messiness of real situations obscures the principles to be learned. In the ZPD-design approach, learning is situated in context such "that meaning, understanding, and learning are all defined relative to actional contexts, not to self-contained structures" (Lave & Wenger, 1991:15, after Borthick, Jones & Wakai, 2003:116). [see below for an explanation of the ZPD, the Zone of Proximal Development] For Vygotsky, learning is the outcome of collaborative problem-solving in whole and authentic activities. (Harland, 2003:270)

## 2.5 Academic Professional education

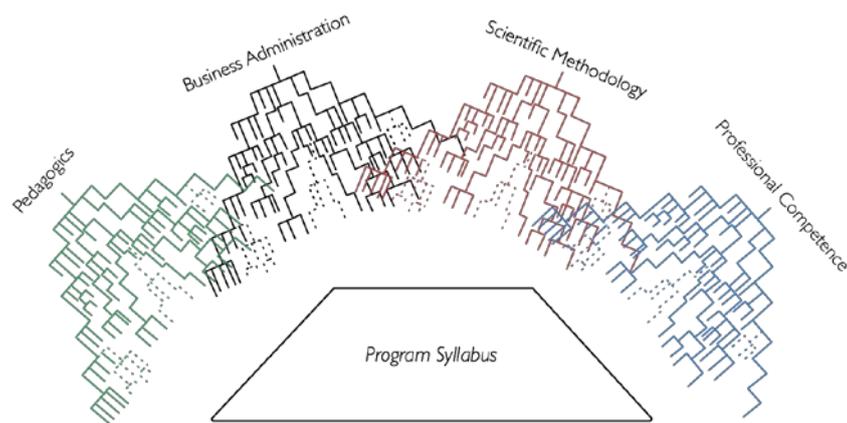
An academic professional education is the complex syntheses of an academic and a professional education. The complexity of the tasks and the necessity to form new knowledge has forced many professional educations to become academic professional educations. Professional training seeks to impose a conformity to established patterns of knowledge and behaviour, while 'education', tries to prepare students to cope with problems, which do not have a ready-made formulaic solution (Kinging, 2002:250). Our students are to 99% not interested in pursuing an academic career. They want to become useful members of a specific community of practice, e.g. auditors. They don't have to be motivated to learn the skills of that profession, rather they question why they need the academic part of the education. And indeed, we must ask ourselves why they need it; why is not a "fachhochschule" education sufficient for this professional community? In some cases it is; in other it is necessary to have an academic professional education. It is necessary when "cookbook-recipes" for solving problems are not sufficient, when problems in the messy reality are ill-defined and when you need to arrive at new solutions to problems. In our case, if you want to proceed beyond the lowest level of management positions, where your tasks cannot be automatised, you need to make a difference: create new knowledge for the company, satisfy consumer needs yet not identified, to produce with new methods, to find new marketing channels, partners, etc. Hence, to solve 80% of the problems in 20% of the time,



with help of cookbook-recipes, and use 80% of the time to solve the ill-defined problems, by using scientific methods.

## 2.6 Four concepts maps

The following image highlights the complex requirements on an academic professional program in business administration. The professional academic program must thus be developed based on the requirements of four concept maps. One each for pedagogics, business administration, social science methodology, and professional competence. It also indicates the foundation for structuring and managing this complexity. The syllabus of a new program in business administration must fulfil the requirements of all these concept maps.



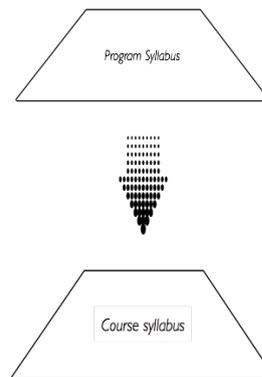
**Image 3. The Program syllabus based on the requirements of our concept maps, own.**

## 2.7 The 'synapsis' of the concept maps

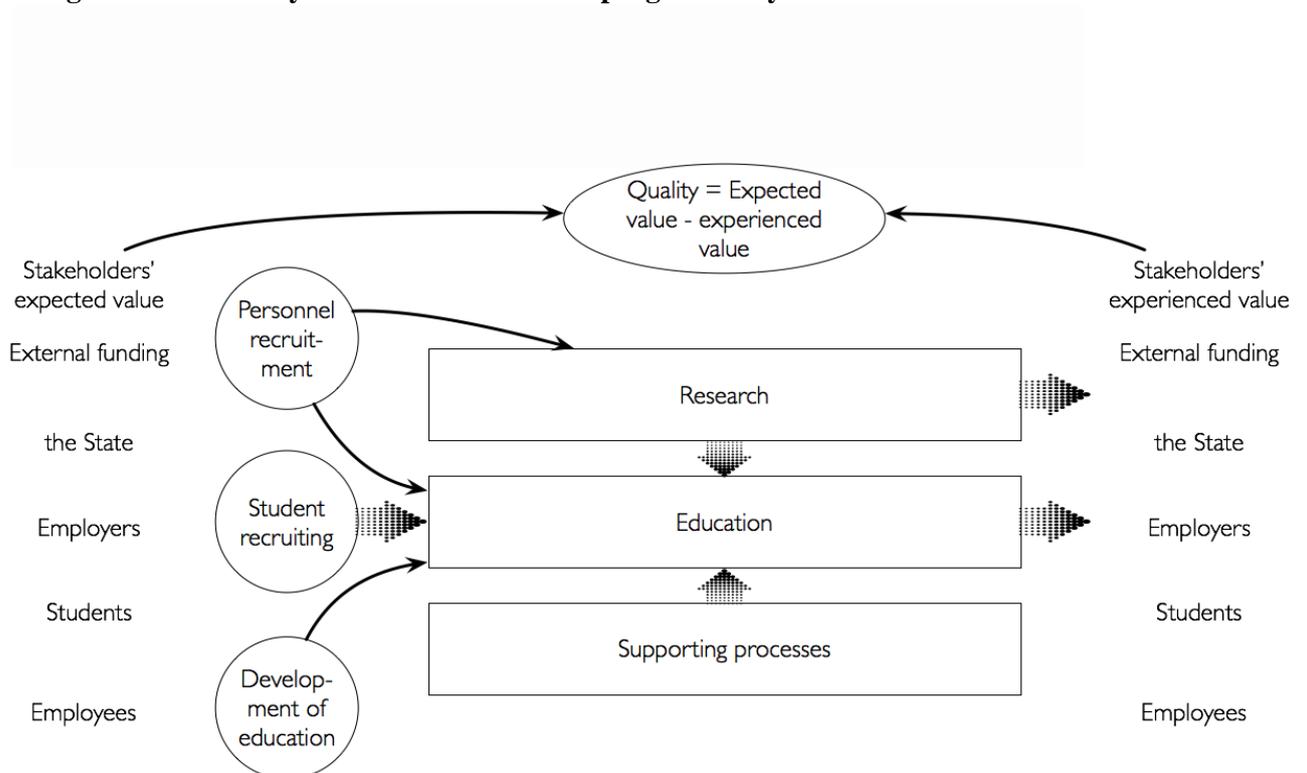
As in the brain, where experiences are connected by synapsis, the concept maps must not be isolated hierarchical tree-structures. They must be interrelated by experiences that show the determinations of one structural element to another. An example of this is that marketing students need a fundamental understanding of finance, to understand the status of the firm's competitors. It cannot be left to another functional speciality to deliver a financial analysis of a competitor; the marketer must understand the importance and meaning of this knowledge.

## 2.8 Course syllabus

The course syllabus are steps in achieving the programme syllabus; its objectives are given as its role in the organisation of the program.



**Image 4. The course syllabus as a result of the programme syllabus**



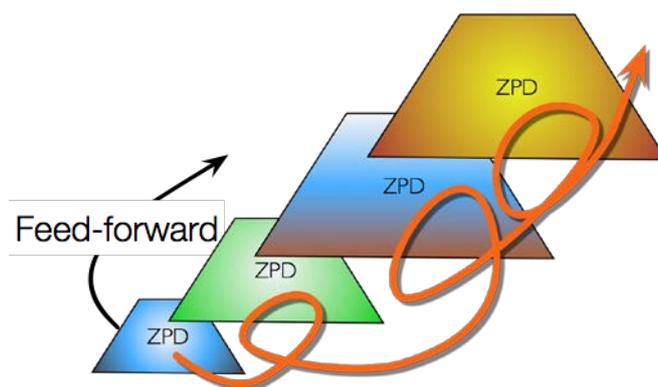
**Image 5. Quality, own.**



## 2.9 Quality

Quality is the gap between expected and experienced competence; research, etc. We do not have a customer; we have many stakeholders, who's sometimes contradictory interests we must balance. In creating the educational programme the necessary depth and bread in the scientific subject(s) and scientific method has to be included. The stakeholders spontaneous expectations are that we will fulfil their requirements, but it is our profession to balance these and create the good education. To ensure that we deliver to their expectations we have to "sell" the education to them, to convince them that the education is good, and to ensure that their experiences will match or surpass their expectations, i.e. to engage them.

Learning goals are the competencies that the students are expected to achieve as a result of the education. Grade criteria must be defined, for how students' achievements are graded in terms of the learning goals. The learning goals need to be operationalised; we need to be able to measure how the learning outcomes are achieved. Such measurement permits us to *feed-forward* the actually achieved learning goals. We must not have the illusion that the achievements are what is planned. By measuring the achievements in a concrete operationalised way, each course can feed forward to coming courses the gaps that have to be compensated in the following courses (see below for an explanation of the Zon of Proximal Development, ZPD).



**Image 6. Feed-Forwarding**

### 3. Entrepreneurial learning

#### 3.1. The psychological paradigm of Vygotsky

One major problem in higher education presently, is its lack of foundation in a consistent pedagogic ethos. We have chosen to implement a learning environment based in Vygotsky's psychology and pedagogics.

Vygotsky's psychology is today the basis of one of the dominating schools of pedagogics, and of Luria's school of neuropsychiatry. (Vygotsky, 1970; 1987; 1993; 1997a; 1997b; 1998; 1999; 2009b; Luria & Yudovich, 1971; Luria, 1977a; 1977b).

In an academic professional education, concept maps must be broken down into sub-maps of suitable "chunks" of knowledge to create Zones of Proximal Development. "It has been shown that the ways in which scientific understandings develop tend to follow 'common conceptual trajectories' (Driver et al., 1994). An awareness of these trajectories (gained from surveys into misconceptions) allows certain developmental pathways to be anticipated by the teacher. From this, a careful sequencing of teaching materials to reflect these trajectories should promote meaningful learning.", (Kinchin, Hay & Adams, 2000:52).

These chunks should be constructed to include interrelated sub-maps of the synthesis of the different fields involved in the education. E.g., in studying consumer behaviour, not only should theory about consumer behaviour be learned, but the students should also learn theory about how to conduct observations, actually do systematic observations of consumer behaviour, analyse these with statistical or qualitative methods, and finally (to better adapt to consumer behaviour) suggest changes in the layout of the retail store studied. The teacher would use these observations in her own scientific research together with the observations done by other students and then return this research to the students, in order for them to reflect and problematise their own and the teacher's results.



### 3.2 The Gestalt; sense

Sensory cues evokes *mental imagery* based on earlier experience (Holbrook, 1982). This imagery is the essence of *tacit knowing*. A word's sense is the *aggregate* of all psychological facts [*gestalt*] that arise in our consciousness as a result of the word. (Wertheimer, Brett, King, Peckler & Schaef, 1992). "Gestalt psychology, on which I am drawing throughout this attempt to establish the logic of tacit knowing," (Polyani, 1962: 604). *Sense* is a dynamic, fluid, and complex formation that has several zones that vary in stability.

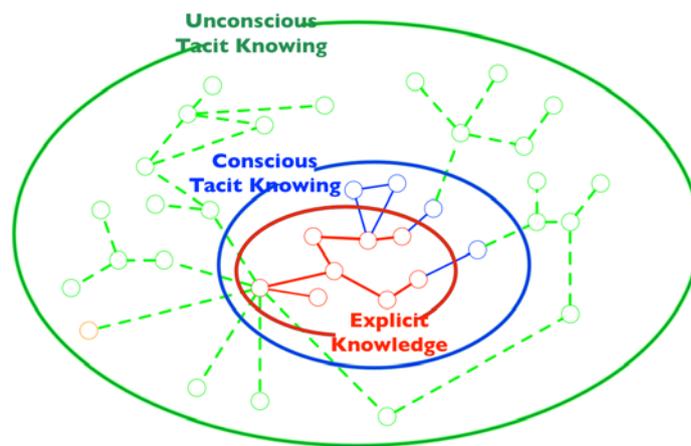
Meaning is often conceptualised as external and sense as internal, *meaning can be seen as explicit knowledge and sense as tacit knowing*. "Both the way we endow our own utterances with meaning and our attribution of meaning to the utterances of others are acts of tacit knowing. They represent sense-giving and sense-reading within the structure of tacit knowing." (Polyani, 1962:301). Meaning is only the most stable and precise zone of sense (Mahn & John-Steiner, 2002:51).

Explicit knowledge is readily communicable, because it has a negotiated meaning in smaller or larger social circles. At least within a community of practice. The conscious tacit knowing is not readily communicable, even if the holder wants to communicate it, as it has yet no or not enough shared meaning with those she wants to communicate with. To negotiate meaning is itself a difficult task facing the designer, who wants to interact within her community of practice. Unconscious tacit knowing is not accessible by the individual herself. It has to be re-voiced by measures unknown to the individual and it is even more difficult, if not completely impossible for another person to provoke the making conscious of such knowledge. "Intuition... fills the gap left open in my previous section on the dynamics of tacit knowing." (Polyani, 1962:322) But in other places seems to see unconscious knowing *only* as subsidiary structures: "The grounds of all tacit knowing are items – or particulars – like the stereo pictures of which we are aware in the act of focusing our attention on something else, away from them." (Polyani, 1968:29:32).

What I call unconscious tacit knowing does not primarily refer only to subsidiary functions, but also to what Polyani himself calls intuition and to which we shall probe further later. There is no absolute distinction between conscious and unconscious knowing; as experience grow and deepen old experiences retreat to the



background and new ones are taking the foreground. Neither is there is a garbage can at the end of this displacement. Subdued unconscious knowing can come to the foreground again, provoked by new experiences or tacit inferences of old ones. The distinction between explicit, conscious and und-conscious tacit knowing is of course fuzzy.



**Image 7. Explicit knowledge, conscious tacit knowing and unconscious tacit knowing, own.**

### 3.3 From where comes thought?

Thought is not born out of thought: "Thought has its origins in the motivating sphere of consciousness, a sphere that includes our inclinations and needs, our interests and impulses, and our affect and emotions. The affective and volitional tendency stands behind thought. Only here do we find the answer to the final "why" in the analysis of thinking." (Vygotsky, 1934/1987:282, after Mahn & John-Steiner (2002:47).

### 3.4 The importance of affect in cognitive development

Vygotsky focused on the affective aspect of learning: Without the exploration of the relationship of the word to motive, emotion, and personality, the analysis of the problem of 'thinking and speech' remains incomplete. The relationship between meaning and sense, and the relationship of intellect to affect, were the focus



of much of Vygotsky's work in the last years of his life (Mahn & John-Steiner, 2002:50).

Vygotsky believed that affect and intellect are not two mutually exclusive poles, but *two inseparable mental functions* (Levykh, 2008:85). He emphasised that culturally developed emotions are socially constructed, as they are internalised, they play a key role in shaping motivation and thought (Levykh, 2008:92): "While some aspects of Vygotsky's work are receiving increased attention and appreciation among educators internationally, his writings on the relationship between affect and thought remain largely unknown, although they are central to understanding his work as a whole." (Mahn & John-Steiner, 2002:46). "The individual emotional experience (being part of personality) seems to be foundational to (consciously, subconsciously, and unconsciously) the person's perception, attention, memory, decision making, behavioral mastery, and overall world orientation." (Levykh, 2008:84).

This "motivational" aspect of education was also the basis for Freire (1973; 1974a; 1974b) and Freinet (1993). "According to Vygotsky, culturally developed emotions can be used as psychological tools to master the child's learning process and behavior, and to develop personality and overall cultural growth. "Emotion," he argued, "is not less important a tool than is thinking" ... in helping the child mediate the transition to a higher level of behavior and learning." (Levykh, 2008:94)

### **Motivation is the mediation between emotions and thought.**

"...*motive* gives birth to thought, to the formation of *thought* itself, to its mediation in the *internal word* to the meanings of *external words*, and finally, to *words* themselves" (Mahn & John-Steiner, 2002:55). "A teacher's awareness of students' ways of perceiving, processing, and reacting to classroom interactions – their *pe-rezhivaniya* – contributes significantly to the teacher's ability to engage the students in meaningful, engaging education." (Mahn & John-Steiner, 2002:53).

My conclusion is that to give such confidence the teacher must have a long relation with the students; thus *giving preference to programmes*, rather than individual courses.



### 3.5 Lived experience

For Vygotsky "...the learning process was not a solitary exploration by the child of the environment; rather, it was a process of appropriation by the child of the methods of action existent in a given culture. In such an appropriation, a crucial rule is played by symbolic tools – signs, linguistic and mathematical systems, and so on." (Kozulin & Presseisen, 1995:67). "Hegel linked the emergence of human consciousness and self-consciousness to this process of mediated activity, which is work." (Kozulin & Presseisen, 1995:68). Lived experience is forming the individual and her personality, Vygotsky's concept *perezhivanie*, often described as 'lived or emotional experience. Every student is formed by 'the specifics of their past experiences" (Mahn & John-Steiner, 2002:49-50).

These lived experiences are fundamental to the understanding of individual learning styles and culturally contextualised learning (John-Steiner & Mahn, 1996:198). "As Luria (1934/1987) pointed out in the afterword to *Thinking and Speech*, Vygotsky focused on this affective aspect of learning and made meaning central to his theory: Without the exploration of the relationship of the word to motive, emotion, and personality, the analysis of the problem of 'thinking and speech' remains incomplete. The relationship between meaning and sense, and the relationship of intellect to affect, were the focus of much of Vygotsky's work in the last years of his life." (Mahn & John-Steiner, 2002:50).

### 3.6 Internalisation and Externalisation, explicit knowledge and tacit knowing

The basis for Vygotsky's pedagogics is his developmental psychology. To understand how we learn we must understand the origins of thinking in humankind and in the individual human being.

The child is essentially born autistic, with an information overload, overwhelming the small capacity of the brain. Experiences forms a pre-understanding and gradually a 'grid' of pre-understanding is built, filtering sensory information considered redundant. Not until the grid is 'fine' enough to balance the sensory information and the capacity of the brain, can the brain begin to develop higher mental functions, built on self-reflectiveness, the meta-understanding of the child by itself. This evolutionary feedback-loop of pre-understanding is what Bateson (1979)



called mind, which could be said to be the in experience built pre-understanding on how to successfully interact with the environment in a certain type of situation ('action' – 'reaction from environment' – 'reflection' – 'repeated action' – 'reaction from environment' – 'reflection' – 'habit'). The minds, as the 'atoms' of experience, consist of both explicit knowledge and tacit knowing. This knowledge can be correct or false, ideology (Marx, 1968), or a mixture of correct and false. As the grid of minds becomes finer and finer, with age and experience, it becomes ever more difficult to relearn to get a more relevant mindset, as the grid filters the sensory information that might provoke the insights necessary for such change. Hence the very processes necessary for our development beyond the animal, are also what trap us into our limitations of being human.

Knowledge is not internalised directly, but by the use of psychological tools. These are not invented by the individual in isolation. They are products of socio-cultural evolution, to which individuals have access by being actively emerged in *the practice of the communities*, of which they are part (John-Steiner & Mahn, 1996:193). Culturally developed emotions can be used as psychological tools to master the learning process and behaviour, and to develop personality and overall cultural growth. Emotion is not less important a tool than is thinking to mediate the transition to a higher level of behaviour and learning (Levykh, 2008:95).

### 3.7 ...and Tacit Knowing

Human experience is diverse and individual. Hence, the associations are not the same from one individual to another. *Tacit knowing* could be said to be *the mass of such associations* in an individual. "...tacit knowing is indispensable and must predominate in the study of living beings as organised to sustain life." Polanyi (1961b:13)

*Creativity* is the result of *associative synapses* in the brain, built on the internalisation of past experiences and how these have been interpreted and given meaning and sense. With a rich network of *unusual loose link associations*, those that do not have the same associations consider the individual to be creative.

I agree with Gourly (2002) that Polanyi is talking about *tacit knowing*, not tacit knowledge. I even hold that tacit knowing does not result in tacit knowledge; there is no separate existence of such knowledge outside of knowing as a process.



Actually the characteristics of tacit is that no knowledge is possible, only knowing.

### 3.8 The transformation of tacit knowing to explicit

Nonaka emphasises figurative *language* for converting tacit to explicit knowledge: metaphors and symbols. (Nonaka, 1991:99-100), thus stressing some of the fundamentals of post-modernism. He also cites Max Black's "two ideas in one phrase" definition of a metaphor, this is the synapses between two (hierarchically) unrelated experiences in the brain. By clarifying, through analogy, why the two ideas are related or not a step towards logical thinking is taken. The last step is to make a model. (Nonaka, 1991:101). Nonaka's (1994) treatment of tacit and explicit knowledge as distinctly different (Gourlay & Nurse, 2005:302) is a radical modification of Polanyi, who expressly stated that tacit knowing can be possessed by itself, explicit knowledge must rely on being tacitly understood (Polanyi, 1962:302).

#### **Transformation of socially shared activities**

Vygotsky conceptualised development as the transformation of socially shared activities into *internalised* processes (John-Steiner & Mahn, 1996:192). "The very process of internalisation from social speech (speech for others) to egocentric speech, and then to inner speech (speech for oneself), is not merely emotionally laden, but *originates in human emotions* and desires." (Levykh, 2008:96). [italics added].

#### **Transformation of Tacit Knowing**

*Making explicit is to externalise* (Borthick et al., 2003:118). "...motive gives birth to thought, to the formation of thought itself, to its mediation in the internal word to the meanings of external words, and finally, to words themselves. (p. 283)" (Mahn & John-Steiner, 2002:55). Tacit knowing can be partly transformed to explicit knowledge through *externalisation*. Externalisation is made in written or oral language, visualisation and behaviour, even with odour, fragrance, scent, and aroma. But such a transformation is always incomplete; we cannot transfer the rich sense of tacit knowing into explicit knowledge, the latter is the mere shadow of the former.



The externalisation, the objectifying of the subjective, makes it possible for the subject to “look at” her tacit knowing and reflect on it. ”In the case of visual attention we may speak of looking at the particulars in themselves, as distinct from seeing them while looking at the context of which they form part.” (Polyani, 1961:463) The “looking at” aspect is evident, as visualisation is a very powerful instrument for the designer, architect and product developer. ”...design know-how, is considered to be tacit and is highly, if not totally, inarticulable.” (Wong & Radcliffe, 2000:494).

But images are also the historical predecessor of written and oral language. Oral language was invented by associating guttural sounds with gestures; pointing; ”...to integrate a thing B into bearing on some C, amounts to endowing B with a meaning that points at C.” (Polyani, 1967:301), and concrete images drawn in sand or clay, these images, which hence preempted oral language were the first written language. ”...the triad of tacit knowing consists in subsidiary things (B) bearing on a focus (C) by virtue of an integration performed by a person (A)...” (Polyani, 1967:302).

Externalised knowledge is however not necessarily immediately understandable to others. It might need interpretation, a transformation into more explicit knowledge, based on a - more - common frame of reference. This translation problem is the basic problem of knowledge transfer.

Tacit knowing is not limited to know how, it also includes know what, or know why. Tacit knowing is often said to be made explicit by socialising, but socialising only makes it possible to *imitate the behaviour resulting from tacit knowing*, not tacit knowing in itself. It takes long time; the apprentice normally needs three years to become a journeyman, who needs another three to four years to become a master (doctoral student, doctor, senior researcher). This imitation internalises the behaviour of the master, but not his or her tacit knowing. It allows the apprentice to imitate the behaviour of the master, but not to switch to another behaviour, when it is necessary; unless the apprentice develops a suitable own tacit knowing that allows her to identify the necessity to change behaviour. Not all apprentices have the talent (the ability to acquire the necessary tacit knowing) to become journeymen, not all journeymen become masters and only a few become grandmasters (maître de France), or professors.



Building structural capital based on observing behaviour based on tacit knowing will lead to bureaucratisation, rather than actually acquiring the tacit knowing of the employees (cf. Philipson, forthcoming).

### 3.9 Explicit Knowledge

Explicit knowledge is harboured in the brain, and has been tacit knowing before it became explicit. But it is still associated with tacit knowing, which makes *explicit knowledge intrinsically tacit* (Polyani, 1962:314). Tacit knowing often cannot be accessed by language metaphors, as suggested by Nonaka (1994:19ff), instead we use the origins of language metaphors – images. "...if all knowledge is fundamentally tacit, as it is if it rests on our subsidiary awareness of particulars in terms of a comprehensive entity, then our knowledge may include far more than we can tell." Polyani (1961:467) "*All knowledge... is either tacit or rooted in tacit knowledge.*" Polyani (1961:314; 1968:42) [italics in original]

Gestures and images preceded language in human development and are 'closer' to tacit knowing. The externalised knowledge is however not necessarily immediately understandable to others. It might need interpretation, a transformation into more explicit knowledge, based on *a - more - common frame of reference*. This translation problem is the basic problem of knowledge transfer.

### 3.10 The Knowledge Metabolism

In externalising the process is reversed; complicated mental images, tacit knowing, are expressed in drawings, signs, etc. for *own reflection*, and for *reflection with others*. While explicit knowledge can be directly expressed in words, the mental "digestion" of internalising, externalising, and then again internalising, gives no precedence for language!

*The focus on oral and written language means a focus on already explicit knowledge; a knowledge that is much more penurious than tacit knowing. As tacit knowing is not accessible for anyone else than the individual holding it, we can only approach tacit knowledge by catching it in the externalisation, where explicit knowledge has a closer relation to tacit knowing than in knowledge that is communicated through language. [Obs! the use of the word metabolism here should not be understood as if we only substitute an organismic analogy to that of Nona-*



ka's mechanistic analogy (the knowledge engine), but should only be understood as a graphical description.]

The knowledge metabolism begins with (1) internalisation through socialisation, (2) integrating the new knowledge with the existing knowledge base; both explicit and tacit (synapses are created with earlier experiences), (3) the new knowledge become enriched by this integration. (4) then we externalise what is meaningful to externalise again, because it would *not* be tautologic to the just internalised knowledge. (5) We then *dialogue* about the meaning and "compare notes" about different experiences.

### 3.11 Language

Almost all sociocultural researchers place language in a central position; however some consider that other semiotic means are of little theoretical interest. We claim a pluralistic rather than a monistic theory of semiotic mediation and coined the term cognitive pluralism for this stance (Kouzulin, 1990). "*Evidence for cognitive pluralism includes the planning notes of experienced thinkers, which incorporate words, drawings, musical notes, and scientific diagrams.*" (John-Steiner, 1985, after John-Steiner & Mahn, 1996:193). Vygotsky "...wrote of drawing and play as preparation to literacy." (John-Steiner & Mahn, 1996:203). "...diagrams are more explicit than lists about sequence, about more or less determinate relationships, and about pathways of influence." (Weick, 1995:388-389). Vygotsky listed several semiotic means, such as language, various systems of counting, mnemonic techniques, algebraic symbol systems, works of art, writing, schemes, diagrams, maps and mechanical drawings, all sorts of conventional signs (John-Steiner & Mahn, 1996:192-193).

And more specifically, "...the use of language is a tacit performance; the meaning of language arises, as many other kinds of meaning do, in tacitly integrating hitherto meaningless acts into a bearing on a focus that thereby becomes their meaning." (Polyani, 1967:315).

### 3.12 Sketches

Ferguson (1992) identifies three kinds of sketches, which may be useful for identifying the role of sketches in creative design groups: the thinking sketch, the talk-



ing sketch, and the prescriptive sketch. "...imagination is a creative transforming activity which moves from one form of concreteness to another.", Vygotsky (2009:282) "...different images may prove to be powerful means for calling forth, exciting and relieving different feelings." (Vygotsky, 2009:284). Cf. also Freire's (1963; 1974a; 1974b) conceptually loaded images, as a means to develop understanding "...where creation of some sort of new concrete structure, a new picture of reality, of a creative embodiment of some sort of idea, becomes indispensable for the process of understanding or the process of practical activity, there we find fantasy coming to the fore as a basic function. It is with the help of fantasy that not just literary works, but all the scientific inventions and technical achievements are created." and "...both the concrete and abstract aspects, as well as the subjective and objective ones, are frequently found in a state of complex interlacement with each other. Objective expression may be coloured by vivid emotional tones, but subjective fantasies are also often observed within the sphere of objective creativity." (Vygotsky, 2009: 285). "The fact that drawings are usually accompanied by verbalisations (in the case of the individual designer this would just be unspoken thought) supports the idea that sketches only partially represent ideas in mind. In general, *a drawing act* in sketching is not an attempt to represent a solution as such, rather it is *a notational device* that helps its creator *to reason with complex and labile mental structures*.", Scrivener & Clark (1994:114, after Van Der Lugt, 2005:106).

**Thinking sketches** refer to designers making use of the drawing surface *in support of their individual thinking processes*. (Ferguson, 1992:96) Engineers use the thinking sketch "...to focus and guide nonverbal thinking" (Van Der Lugt, 2005:97). The externalisation of conscious or semi-conscious tacit knowing creates a virtual "other", with which to dialogue. This dialogue can provoke semi-conscious and unconscious tacit knowing to surface to higher level of consciousness. "Doodling, drawing, modeling. Sketch ideas and make things, and you're likely to encourage accidental discoveries. At the most fundamental level, what we're talking about is play, exploring borders." (Kelley, 2001:38).

**Talking sketches** refer to designers making use of the (*shared*) drawing surface *in support of the group discussion*. Ferguson (1992:97) states: "...talking sketches, spontaneously drawn during discussions with colleagues, will continue to be important in the process of going from vision to artefact. Such sketches make it easi-



er to explain a technical point, because all parties in the discussion share a common graphical setting for the idea being debated”.

This is the negotiating of meaning, to be able to express and dialogue around previously individual conscious tacit knowing, but now explicit knowledge in a limited community of practice, a group. The characteristics of the group is that it has a very detailed and profound negotiated meaning, developed from a common professional education and praxis. For others in the group an intervention might provoke a discourse based on explicit, conscious tacit knowing and even provoke unconscious tacit knowing to surface to consciousness. This dialogue can develop new knowledge, but the discourse itself is limited by what can be made explicit.

*Prescriptive sketches* refer to the designers *communicating* design decisions *to persons* that are *outside of the design process*, hence outside the community of practice referred to earlier. Ferguson (1992:97) describes the prescriptive sketch as the means for the engineer: to direct the drafter in making a finished drawing. The communication must be based on a negotiated meaning limited by a common culture. This is also why early prototyping is advantageous for the success of innovations. "...visualisation techniques that support the involvement of diverse stakeholders in the process, a user-centred approach to complement top-down methods, fast prototyping to rapidly test models in practice, and systemic approaches to food, energy and care systems." (Mulgan 2009, after Hillgren, Seravalli & Emilson, 2011:171). "Good prototypes don't just communicate—they persuade." (Kelley, 2001:39).

But the same holds for the verbal externalisation; first we write for ourselves; then we need to communicate it in a community of praxis, whether it is family, kinship, or close friends for everyday experiences, or a community of professional praxis; and finally a prescriptive text or speech for a broader audience. The talking sketches and their language equivalents are the mediation between tacit knowing and explicit knowledge. The essence of the dialogue in this mediation process is problematisation (Alvesson & Sandberg, 2011; 2013).

### 3.13 The zone of proximal development

The zone of proximal development means that we learn by doing things we don't know how to do and then reflect on what we have done: "...the only good kind of



instruction is that which marches ahead of development and leads it...”; to lead the student "...to what he could not yet do.” (Vygotsky, 1970:104).

The ZPD is the distance between the actual developmental level, as determined by independent problem solving, and the level of potential development, as determined through problem solving under adult guidance or in collaboration with more capable peers (Dunn & Lantolf, 1998:415; Borthick et al., 2003:114).



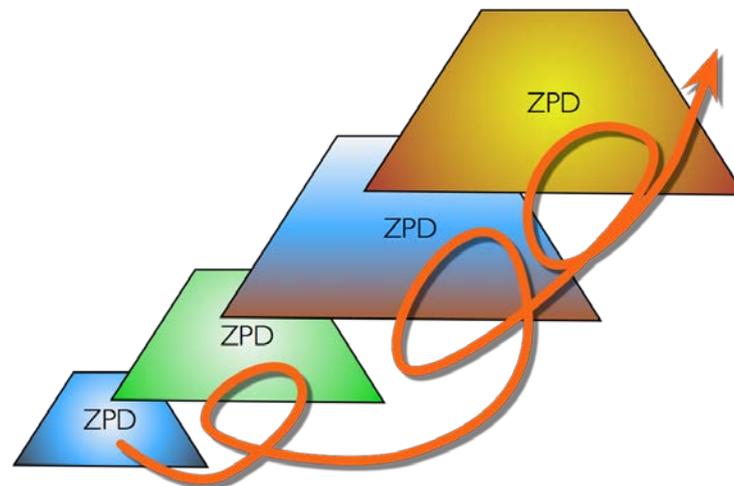
**Image 8. Zone of Proximal Development**

”A central premise of ZPDs and the sociocultural theory associated with them is Vygotsky's (1978,1986) idea that developing mental function depends on learners internalizing the performance of the capabilities they are learning. Internalization occurs faster when learners have assistance for the specific task aspects they cannot yet perform on their own. The assistance can be provided by an expert or a more capable peer.” (Borthick et al., 2003:114). ”The ZPD is thereby interpreted as a knowledge-creating activity rather than as a tool, place, or space merely for ensuring effective transmission of predetermined knowledge...” (Kinger, 2002:247). ”Mastery of learning activities (tools) leads to mastery of environment, while the mastery of environment, in turn, leads to mastery of one’s own behavior. That is, whatever was experienced by the group is later experienced by the individual.” (Levykh, 2008:93).

A course should be a feasible challenge for the student; the Zone of Proximal Development; ZPD, the space in which the student can do what he or she do not yet know. To identify each student’s zone of proximal development it is necessary for the teacher to build a long-term social relation with the student, tests will not give



enough knowledge. Hence, it is necessary to build such learning environments that permit that such long-term relations are built.



**Image 9. The gradual expansion of the Zone of Proximal Development, own.**

### 3.14 What the students already know

In order to create an appropriate ZPD it is necessary to dialogue with teachers on high-school level, to learn their core capabilities and rigidities (Leonard-Barton, 1992), we can expect of the students coming to the universities.

### 3.15 What happens in the zone of proximal development?

How to work in the ZPD? We have identified seven themes in the literature, the groups in which learning collaboration is done; the roles that the students take in collaborative work, the characteristics of the dialogue in collaborating, necessary care and support, shared values, the psychological tools and artefacts used, and scaffolding.

**Groups:** "...heterogeneous grouping is beneficial for both high- and low-achieving students (Weber, Welner & Zuniga, 2001, after Gijlers & De Jong, 2004:280). "...students who participated in groups that were heterogeneous with regard to comprehension ability attained competence more quickly than students in groups that were homogenous." (Sullivan Palinscar & Herrenkohl, 2002:31). Students learning from students needs to a vital element of the learning environ-

ment. Vygotsky holds that, apart from the teacher, students also learn from more able peers.

**Roles:** "...every participant in the group will be responsible for leading the dialogue and will receive the assistance necessary to do so." (Sullivan Palinscar & Herrenkohl, 2002:27). The 'how to' dialogue has to be learned, and can't be expected to be known.

**Dialogue:** "Careful listening, intense dialogue, and emotional support sustain the cooperative construction of understanding, of scientific discovery, and of artistic forms. This is true in interaction across generations – in parenting, teaching, and mentoring – and among creative partners." (Mahn & John-Steiner, 2002:51). It is *not lecturing, but dialogue* around the student's performance in the zone of proximal development that promote learning. As stated earlier, the essence of this dialogue is problematisation.

**Care and support:** "...competence is built through dignified, collaborative, caring support..." (Mahn & John-Steiner, 2002:48). There has to be a caring element in the teacher – student relation. This demands time; both in the short and long-run perspective.

**Shared values:** "As was true with RT [Reciprocal teaching], creating a shared set of classroom values that established understanding others' perspectives as an essential aspect of participation was critical to the successful implementation of CTIR [Cognitive tools and intellectual roles].", Sullivan Palinscar, & Herrenkohl (2002:31).

**Psychological tools and artefacts:** "The value of CTIR [Cognitive tools and intellectual roles] has been investigated in several sets of studies (Herrenkohl & Guerra, 1998; Herrenkohl, Palinscar, DeWater, & Kawasaki, 1999). The results indicated that the use of these tools: (a) supported classroom dialogue, (b) advanced student theorizing, (c) influenced student thinking about the nature of scientific problem solving, and (d) promoted conceptual understanding." (Sullivan Palinscar & Herrenkohl, 2002:30). "...not only artifacts can serve as tools.

**Scaffolding:** Scaffolding is a Vygotskyan concept based on the idea of providing supportive assistance to the learner within the parameters of a learner's zone of proximal development (Wood, Bruner & Ross, 1976, after Dabaghi, 2003:39).



But scaffolding seems to have become a rather mechanistic concept, where the teacher, or a more advanced peer, is supposed to create a support structure for the students to work in the ZPD, but Vygotsky envisaged it as being dismantled, when it was no longer needed, and probably also to raise new scaffolding if it becomes evident that the task is not fully in the students' ZPD. "Scaffolding involves supporting novice learners by limiting the complexities of the learning context and gradually removing those limits (a concept known as fading) as learners gain the knowledge, skills, and confidence to cope with the full complexity of the context" (Young, 1993, after Dabbagh, 2003:39). "Scaffolding was conceptualised as the process of providing higher levels of initial support for students as they entered the ZPD with the gradual dismantling of the support structure as students progressed towards independence. Eventually the scaffold would disappear and a new one be built to help construct the next stage of learning." (Harland, 2003:268). The teacher must build the scaffolding necessary for the students to expand within the ZPD, and then gradually remove them. In such an environment the teacher is to identify each student's possible zone of proximal development, enable learning by creating the scaffolding necessary for the students to make the journey. It is not about raising a standard scaffolding, but to improvise based on 'minimal structures', (Kamoche & Cunha, 2001), of scaffolding to adapt to the students hardships. "Emotional scaffolding includes the gift of confidence, the sharing of risks in the presentation of new ideas, constructive criticism, and the creation of a safety zone." (Mahn & John-Steiner, 2002:52).



**Image 10. Scaffolding**

### 3.16 ZPD and tacit knowing

The ZPD is *the feasible learning challenge*. It entails learning by doing what the student can't yet do: *acquiring tacit knowing* and then reflect, individually and in group, with the teacher and more able peers, on what she succeeded to do; thus the tacit knowing is partially becoming explicit knowledge.

### 3.17 How can we catch tacit knowing?

1. We can create ways for employees to share conscious tacit knowing. These are variants of Ferguson's "Thinking sketches".
  - A. By providing environments for them to share tacit knowing (spaces, trust, rewards, etc.). This is mainly what knowledge management has focused so far. Here I propose that Vygotsky's concept ZPD can give much deeper insight, than what has been produced by knowledge management so far.
  - B. By development of "community of practice"-specific "Talking sketches".
2. Some tacit knowing can't be accessed, or not yet accessed. Then we must find ways to "bind" the bearers of that knowledge to the organisation, e.g. by empowering these (see Philipson, forthcoming). Communities of practice can be seen as an attempt to leave knowledge where it is generated and used, and to control it indirectly by managing, motivating, and rewarding people. (Guarlay, 2005:309).
3. We can develop new ways to provoke unconscious tacit knowing to come to the forefront. If tacit knowing, as demonstrated, is just tacit and not, or hardly not made explicit for the holder, then tacit knowing must be provoked 'in vivo', through 'sensory cues' (sketches, models, scents, flavours, etc.) to get a reaction based on tacit knowing. But the fundamental problem is that without knowing the tacit knowing an individual holds, how are we to know what sensory cues that can provoke this tacit knowing?
4. Other methods to catch tacit knowing in the process of becoming explicit are social network analysis (such as InFlow, 2013-05-04; Leximancer, 2015-07-23; Cmap Tools, 2015-07-23), or brain-sketching with interviewees, as suggested by Van Der Lugt (2005). "Motion studies may teach us to identify some of the elementary acts constituting a skill, and this may be useful in training." (Polyani, 1962:601). An example of such motion studies are those made by the late Professor Carin Boalt at the Swedish "The Research Institute of the Homes" in 1944-1957, to improve the working conditions in kitchens and laundry rooms, by new architectural layouts of those spaces.



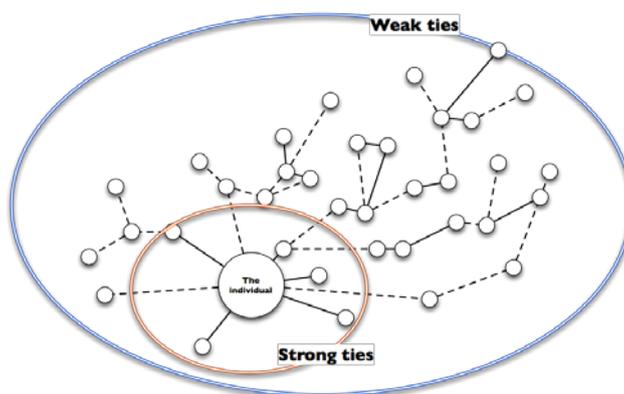
### 3.18 Learning communities ...and beyond

Learning is based on long-term collaboration: "Participants needed to feel *safe* enough to enter what could feel like a strange community." (Jones & Issroff, 2005:403). "Knowledge emerges through the network of interactions and is distributed and mediated among those (humans and tools) interacting..." (Cole and Wertsch, 1996, after Lipponen, 2002:74).

But even if a well-functioning learning community is the students comfort zone, we must ask ourselves: "How then, should one speak about and analyse collaboration at the collective (macro) level? One idea would be to think about communities as interaction networks, and interactions representing strong and weak links among participants. Links among community members that frequently meet each other are usually strong, and conversely (see Granovetter, 1973)." Lipponen, 2002:75).

In his groundbreaking work on the link between small groups, the family, kinship, or other close-knitted groups, and the larger society, Granovetter (1973) explains the key role of the weak ties, as opposed to strong: "...weak ties... are ...as indispensable to individuals' opportunities and to their integration into communities; strong ties, breeding local cohesion, lead to overall fragmentation.", Granovetter (1973:1378).

He explains how the weak ties build society, as opposed to kinship loyalty.



**Figure 11. The weak ties, after Granovetter (1973).**

Hence to produce new knowledge *it is not sufficient to work in a learning community*, but the students need to extend beyond that, through the members weak ties to the society at large. "For Engeström, the emergence of historically new educational practice implies the involvement of life outside the classroom..." (Kinging, 2002:246)

## 4. Building structural capital

The economic restrictions mentioned in the problematisation forces us to invent new methods in creating new learning environments. Typically social science education can only provide students with some 7 hours of weekly teacher-lead education. This could be doubled using modern pedagogical methods, where the teacher is more a mentor and a constructor of the scaffolding necessary for the students to learn themselves and from their more able peers.

Today most Swedish universities pay professors four hours for preparing and holding a lecture hour and then examining it (personal experience from teaching at 6 Swedish universities). This is ineffective and still focusing on old time pedagogics; teaching instead of learning. With a library of pre-recorded lectures (by the teacher, one of her colleagues, bought, or found free from TED, Youtube, Stanford, or MIT), the teacher use these as food for thought, dialoguing with the students, problematising the message in the mini-lecture. For this the teacher will be paid only two hours for one hour in class, thus giving the students double the time of comments, feedback, and presence. As stated earlier, this increased presence is also necessary to identify a need for re-scaffolding (dismantle obsolete scaffolding, raising new, more appropriate to the specific student body).

### 4.1 An expanding learning environment – Building intellectual capital in higher education

Since social science education mostly work with very limited resources (in Sweden 1/4 to 1/3 of those in technological or medical education), the possibilities are limited for educational institutions to invest in the building of *excellent learning environments*. Hence, it is necessary to take a long-term perspective and build on existing learning environments, but also to use the students' capacities to partici-



pate in the building of new knowledge and new learning environments, sometimes called crowdsourcing<sup>1</sup>. ”Engeström (1987)... characterizes the ZPD as the basic category of research on ‘learning by expanding’. Here, the ZPD is seen as a collective process by which historically new forms of social activity are generated through joint co-operative action. The process begins with the perception of a societally essential dilemma, or ‘double bind’ embedded in everyday actions, one that cannot be resolved through individual action alone, and the result is societal, along with individual change.” (Kinging, 2002:246; Freire (1973; 1974a; 1974b; Freinet, 1993). An expanding learning environment, where the students are not only re-creating knowledge, but *expanding the human knowledge base*, is the future goal for professional academic educations, serving society by not only delivering future adepts to professional communities, but also to critically evaluate the praxis of these communities.

Gaming adventures are perhaps a future vehicle for learning. These have has been shown to give students great *motivational drive* (Steinkuehler, 2004), but until they can be shown to also foster *empathy*, we are concerned that they will add to the apparent deficit of empathy in today’s society, (Guardian, 2013-05-01).

### 3.2 What the student brings with her

The student should be able to bring with her a *portfolio* of experiences, concepts, and analytical methods, to use in future work life. These are organised as concepts maps. This portfolio should have a digital presence, allowing the student to give *html synapses* between them. All three of the most common word-processors, MS Word, Apple’s Pages, and Open Office, gives such a possibility.

### 3.3 Example 1: First course in Accounting<sup>2</sup>

- Groups of two students are ”employed” for a week to work in a small retail store, kiosk, coffee shop, etc. The owner instructs the students.
- The students are asked to identify principal stakeholders in the store (owner, the state, employees, suppliers. customers, financiers, etc.). They are

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<sup>1</sup> The practice of obtaining needed services, ideas, or content by soliciting contributions from a large group of people and especially from the online community, rather than from traditional employees or suppliers, Mirriam Webster Dictionary (2013-05-03).

<sup>2</sup> Credits to the Technical University of Luleå, Sweden for the idea.



further asked to identify the respective interest these might have in the store (profit, TVA, salaries, etc.).

- The teacher introduces the concept of account plan and ledger.
- The two students that worked in the same store are asked to construct an account plan for the store that makes it possible to track the interests of the different stakeholders.
- The students are given a paper bag with all the receipts and all the payments made for the last year. They are given 48 hours to enter all in a ledger and to make the annual income statement and balance sheet for the store.
- After the evaluation of the assignment, the teacher introduces the concepts of: going concern and accrual accounting.

### 3.4 Example 2: Course in Service Management

- Let's say that there are 60 students in the Marketing program (example from Linnaeus University, Sweden).
- Individually the students are asked to write down what they would consider *quality* for each of three products. For each of three specific brands they are instructed to write down their *expectations* of the product. After having bought these three products, they are asked to write down what their *experience* of the product was.
- In groups of two, they are instructed to interview 30 customers in a retail store the same questions about quality, expectations, and experiences.
- In class the 900 (60/2\*30) interviews are analysed by the students with suitable statistical analysis.
- The teacher introduces the scientific concepts of service quality, measuring service quality, and customer loyalty.
- The teacher publishes an article based on the data.
- After five years, the longitudinal data of 4500 (5\*900) interviews are presented on and reflected in class. This is an example of an expanding learning environment.
- The teacher publishes article based on longitudinal data.
- To later classes the teacher feedback this meta-study, after the class in question has produced their own set of empirical data and analysis.



*A framework for entrepreneurial learning in higher education*

- In this example the student goes from individual experience, to collective experience in a community of practice and then twice to a widened experience outside the community of practice and reflection in between these.



## 5. Conclusion

We introduced concepts maps as a tool to build academic professional educations, and discussed Vygotsky's pedagogic and Polyani's concept of tacit knowing. Together they enable "entrepreneurial learning", where acquiring tacit knowing proceeds the externalisation of reflected explicit knowledge through learning processes developed by Vygotsky, complemented with methods and tools to catch tacit knowing "on the fly".

Groups sharing a community of practice can dialogue around *recently externalised* knowing, dialogue around these experiences and gradually widen the experiences, and dialogue around these widened experiences, in order to acquire a reflected explicit knowledge.

By documenting acquired knowledge in a portfolio of hypertext-related concept maps, the individual gets an externalised mirror of aspects of their tacit knowing and also becomes part of a continuously expanding learning environment, where explicit knowledge of students and researchers are combined into an increasing common knowledge-base.

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