PBL and Creative Processes

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INTRODUCTION

Problem Based Learning (PBL) is a pedagogical approach that encourages those who take part in its processes to act both as supportive change agents working in collaboration with colleagues, and also as individuals to use their creativity in finding solutions to practical problems. The process of questioning the issues and finding novel solutions using the creative spirit are also challenging for those who teach and deliver PBL based curriculum, and poses some fundamental questions.

The aim of this special issue was to uncover both theoretical, philosophical, pedagogical and aesthetical aspects of the contradictions and interactions between the collective and the individual in creative learning processes. To this end we need to view the learning process from a variety of different angles, for example, the individual student vis-à-vis group processes, as a personal journey, as a collective journey, and to obtain the insider perspectives of those who teach PBL, and their relationship to professional business partners and studios from real world settings. For example, is it possible to teach creativity as process pedagogy in formal classroom settings, especially within the context of PBL pedagogy?

Are we inhibiting individual creativity at the expense of consensual and collaborative group work problem definitions and solutions? Furthermore, in the design process there are always many ways and solutions to solve the same problem, so how can we be sure that we choose the right concept to finding the optimum solution to practical problems? What is the role of PBL in this context?

How do space, form and materiality impact upon PBL and creative processes? What can we learn from the flow and conflict in the PBL process and how can we improve both the aesthetic and pedagogical aspects of PBL education? The papers and the themes that we

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suggested for this special issue were eclectic, and the submissions received reflected the innovative use of problem-based classroom practice.

The foregoing is exemplified by the *Charlotte Lindvang and Bolette Becks* shared musical journey that uses musical concepts to explore the connection between creative process and social communication and how within PBL group activity social interplay can hinder creativity. As they say sometimes the travel is intense and dramatic, sometime lyrical and flowing, sometimes stationary for a while. The PBL process is a place where you experience new landscapes and learn new skills; it is also a process of common creation and understanding.

Lindvang and Beck turn to Damasio's book "Descartes error" and conclude that 'it is an advantage when the presence of emotions and feelings can be integrated in a balanced way in the PBL group work [and] in PBL it is important to be aware about how thinking and feeling are intertwined and that the balance between thinking and feeling influences the communication and the process'. Furthermore, they say 'Creative processes can be described as third order knowledge, characterized by dedication and absence of control. In the music improvisation the participants do not control what will happen, they open up their minds and they follow the music as it appears'. *Lindvang and Beck* quote Lars Qvortrup (2004) who presents a theory inspired by Gregory Bateson whereby knowledge is categorized as first, second, third and fourth order knowledge. First order knowledge is factual knowledge where knowledge can be accumulated as precursor to reflection on action. Second order knowledge is reflexive knowledge; it is knowledge about knowledge. On this level we can choose adequate methods and use our factual knowledge to solve concrete problems i.e. reflection-in-action. Third order knowledge takes the form of creativity, where we see things in a new and intuitive way (not-yet-embodied-knowledge). Fourth order knowledge (also called "world knowledge") represents the social evolution of knowledge.

The theme of group experience is also a concern of *Ole Pihl*. Here he explores the contradictions between the individual and the group of architecture students. He explores the hidden realties of the PBL-based creative process, and the exploration of artistic progression and intuition within group work. He focuses upon dialogical consensus, this being a central theme to PBL practices, and the evocation and expression of space, form, and materiality. You could argue that any kind of learning process is creative, it becomes more complex when we discuss creative educations as architecture, art and film, here we go beyond words and enter a world of complex images, where each project has a multiplicity of solutions, so how do you decide when you are alone, or in a PBL group, how do you decide what is the best solution? *Ole Pihl* suggests a range of methodological tools based on the study and findings of four different student cases from Department of Architecture and Design at Aalborg University. The focus of his investigations being focused upon the interplay between the individual and the group within the creative process.

Virginie Servant, Gera Noordzij, Emely Spirenburg and Maarten Frens also focus upon creativity within the PBL process. They advance the notion there is a need to educate individuals to be "creative" and "innovative" workers. This they take forward in their findings of the assessment philosophy of creative thinking. They take us though a journey of their PBL process and assessment strategy, whereby hey describe the *Thinking in Possibilities* assessment philosophy, which build from a basic understanding to creative argumentation these being: foundational knowledge questions; application questions; and constructive argumentation. They explain how an open PBL environment balances between the group and the individual. They note that 'Unlike written exams, coursework pieces are prepared at home throughout the block. These assignments assume that students have acquired the foundational knowledge of the relevant disciplines during the PBL meetings and self-study, and therefore aim for a creative application of the course's methods and concepts to situations of a students' choosing. Here, they can demonstrate that they can play with the materials of the course, following their own interest beyond the point, where the discussions in the PBL meetings stop'. This they claim is where problems provide openings to a particular topic, which students can follow if they want to do so in order to discover more than their PBL self-study will allow. This they can do so by presenting their self-chosen assignment titles to their tutor. The students have two weekly PBL meetings with the group and their supervisor. Writing they claim is an absolutely truly creative process that demands a precise interaction between control and play. Writing is indeed a "Blind" art, the image is only in the eye of the beholder and each reader creates his/her own image, and when we discuss our different interpretations new meanings emerge.

The theme of creativity, and knowledge-creation is continued by *Ann Charlotte Thorsted, Rie Bing and Michael Kirstensen* who relay their account of play between the small group of students and their supervisor with the PBL process. This dynamic makes a departure into the implicit teacher-student relationship that is predicated upon a more holistic, trustful, sensitive, open, creative and collaborative dynamic. This lead hen to ask thee central questions concerning the PBL process: What can a more playful approach brig into a PBL learning space? What influence can play have on learning, an on student-to-student and student-supervisor relationships and collaboration? Why did students find that this enhanced a learning that differed from earlier experiences? What was play had mediated? They go on to challenge the traditional PBL approaches, these being regarded as a problem solving approach to learning; their central thesis rests upon play as entrance to knowledge creation or what they call Play and Problem Based Learning, this being a playful, experimenting and intuitive approach.

This they claim engenders a community of play, where students gained confidence and courage to let of their desire to be in control; they engaged with the world more authentically and intuitively, central to the development they claim to create creative students. But to be

creative: 'Intuition requires that we dare to put ourselves at stake, let ourselves be absorbed by the moment and through this get access to the world of our existence, not only as a matter of reaching certain facts or conceptual understandings, but also to let life itself impress us'. This they claim shows a change in the relationship between themselves and their supervisor that engendered trust, and allowed a more personal side to come forward leading to more honest and open dialogues between teacher and students.

Cameron Richards looks at the tensions of reconciling individual and collective aspects of innovative problem-solving; this being the role of PBL as a key focus in the creative process. His recognition of the fast-changing complexity of moderns day challenges is explored via curriculum and assessment design to support authentic problem-based learning for authentic policy challenges of sustainability; posing the question of wicked problems and policy builders of the future. This is articulated in his description of the design of problem-based learning project task in sustainable studies, this being outlined in terms of three stages and what he calls corresponding parts of their project write up, namely: the identification of a rationale; a critical breakdown of the selected policy issue or challenge; the design of a proposed solution. As he notes this requires 'a systematic alignment of the distinct if ultimately axes of human knowledge-building', which culminated as part of an e-portfolio assessment framework supported by a range of supporting individual reflections and activities. This is culminated by the "enneagrammatic" formula of integrated, optimal, and sustainable problem-solving that 'serves to exemplify the possibilities of an integrated systems approach to problem-based learning as well as the generic problem-solving process in every aspect of both social and natural domains of human knowledge.

Säde-Pirkko Nissilä and Esa Virkkula make a comparison as to how musicians from a music conservatory education programme, and engineers who were participating in a trainers for trainers course, approach the practical and abstract solutions to problems; the former using the seven step PBL approach, the latter the 635 PBL problem-solving approach to explain their conceptions of change management at their levels of competence. Whilst both groups used different approaches, they conclude that in both cases process were based on planning and stating the aims and goals by joint planning and reflection, and the recognition of skills. It was also observed that expert dialogue led to the 'demonstration of the problem as work processes'. Furthermore, when comparing the two groups there were more similarities than differences despite the differing approaches adopted, whereby both groups acted 'systematically and creatively'. They conclude that the successful implementation of PBL 'lies in designing a learning environment that stimulates students towards constructive, self-directed, collaborative and contextual learning'.

Problem Based Learning as a Shared Musical Journey – Group Dynamics, Communication and Creativity

Charlotte Lindvang, Bolette Beck *

ABSTRACT

The focus of this paper is how we can facilitate problem based learning (PBL) more creatively. We take a closer look upon the connection between creative processes and social communication in the PBL group including how difficulties in the social interplay may hinder creativity. The paper draws on group dynamic theory, and points out the importance of building a reflexive milieu in the group. Musical concepts are used to illustrate the communicative and creative aspects of PBL and the paper uses the analogy between improvising together and do a project work together. We also discuss the role of the supervisor in a PBL group process. Further we argue that creativity is rooted deep in our consciousness and connected to our ability to work with a flexible mind. In order to enhance the cohesion as well as the creativity of the group a model of music listening as a concrete intervention tool in PBL processes is proposed.

INTRODUCTION

In this paper we are going to elaborate on the problem based learning process as a journey. A journey implies movement, and the concept illustrates that project work is always in

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transition. Further we describe it as a musical journey to acknowledge the qualities and vitality dynamics of the process: sometimes the travel is intense and dramatic, sometimes lyrical and flowing, sometimes stationary for a while. PBL is not only a journey where you experience new landscapes and learn new skills, it is also a process of common creation and composing. Furthermore musical dimensions of expression is intrinsic in human communication and interaction (Trevarthen and Malloch, 2000), and therefore we find it appropriate to call it a musical journey. We also find inspiration in the literature where musical terms have been used to describe group processes (Foulkes, 1983), and thereby we highlight PBL as a social and shared musical journey where dialogues and interplay are necessary to reach a common goal.

The intention of PBL is learning on a high level, through which the students understand the world in a new way, a new light or new perspective – it is a kind of learning that necessitates creative thinking. As we will pinpoint in this article creative processes occur when the students are ready to break with the well-known melodies, the fundamentals of their prior knowledge, and are able to go beyond their repertoire in order to create a new composition. Sometimes the group members have to move to unknown places, where they did not plan to go from the beginning. Therefore creative group work requires openness to experience and a willingness to engage in new ways of listening and playing together.

In addition to our focus on describing the PBL process as an analogy to a music group that improvises together, the other main contribution in this paper is a concrete intervention tool of music listening that can be used to encourage creativity in a PBL group.

Throughout the article we will continue to use musical terminology as metaphor for the processes and dynamics of PBL group work. Thus the music-poetic text will be mixed with academic writing in an attempt to take on the task of embracing the complexity of creativity in PBL. Drawing upon our knowledge and experiences from the music therapy milieu, we hope to inspire educators and students across disciplines, who are embarking on PBL and creativity.

INITIAL THOUGHTS ABOUT PBL IN HIGHER EDUCATION

In this article we focus on PBL in groups. In PBL one of the cornerstones is that each group defines its own learning objectives, identifies one or more problems connected to real world practice and creates its own problem formulation (Savery, 2006). Further the fundamental principles of PBL project work are based on learning through collaborative problem solving and writing up a project together. "The team learning aspect underpins the learning process as a social act, where learning takes place through dialogue and communication" (Kolmos, Du, Holmgaard, & Jensen, 2008). This is a learning process concerning communicative and

relational skills that go beyond the participant's technical expertise (Baden & Major, 2004 p. 4). This specific kind of learning, that emphasizes cooperative learning rather than competitive learning, is needed as an important competence in future teamwork (Krogh & Rasmussen, 2004). Beside the collaborative tasks, one of the main purposes of PBL is to create new knowledge on an academic level. In the Aalborg PBL model the idea is to provide students with an active role in the acquisition and creation of knowledge, to give them better opportunity to locate what they need to know and become self-directed, self-regulated and responsible learners (Kolmos, Fink and Krogh, 2004). Before elaborating further on group aspects in PBL we need to take a closer look at the concepts of knowledge and creativity.

LEVELS OF KNOWLEDGE IN PBL

In his book from 2004 Lars Qvortrup presents a theory of knowledge that was influenced by Gregory Bateson, where knowledge can be categorized into four forms: 1st, 2nd, 3rd and 4th order knowledge. The four categories of knowledge are defined as follows: 1) First order knowledge is factual knowledge - simple knowledge about something, on this level knowledge can be accumulated. 2) Second order knowledge is reflexive knowledge - it is knowledge about knowledge, on this level we can choose adequate methods and use our factual knowledge to solve concrete problems. 3) Third order knowledge is a creative form of knowledge where we see things in a new way; we rise above the concrete situation and see things from the outside, raise new questions and go beyond the taken-for-granted assumptions. 4) Fourth order knowledge is also called 'world knowledge' and represents the social evolution of knowledge. This form of knowledge implies that we are conscious about our knowledge as a part of a common knowledge culture. Following Bateson this particular form of knowledge cannot be contained by one person - it resides within the social community (Qvortrup, 2004; 2006).

In PBL the students work on the levels of first and second order knowledge and learning; they build upon factual knowledge, which in musical terms resembles a stable pulse or rhythm, repetitions and recognizability. On the second level the group members use their situated understanding and reflexivity to discuss and find adequate solutions. In musical terms the group develop dialogues between their different instruments and maybe they try out new instruments and extemporize on well-known material. In order to facilitate creativity in a PBL process the students need to move to the third level of knowledge. In musical terms the group work is then characterized by breaks and surprises, variations or development of new themes or even new styles. On the third level the group might reach a higher understanding of their own functioning: the group can 'hear their own music as they play it' and develop consciousness that exceeds their former understanding of themselves as learners and as a group.

One of the commonalities in creative processes is that new ideas and new thoughts always emerge in an unplanned and non-governing way. Thus, the characteristics are not order but rather chaos (Kupferberg, 2006, p. 17). This way of thinking about creativity can also be used to understand aspects of creativity in a group. To be able to move to the third level of knowledge (Qvortrup, 2004) the group needs to cope with a certain amount of chaos. When the group travels into unknown places they do not control every aspect of the progress and they may momentarily lose overview and direction. At a point in time, a new form of order, insight or knowledge will appear – still with the sense or quality of being created rather than imitated, which would have been 1st order learning (Lindvang, 2010).

GROUP PSYCHODYNAMICS IN PBL GROUP WORK

How can groups be made strong enough to embrace creative chaos, and what is the social learning of such a process? In this paper we are oriented towards the possibility of establishing a space for the joint creative process of the group, and the inherent social learning of such a process. Integrating the concept of Communities of Practice (Wenger, 1998) into the process of creative learning, Krill (2013) argues that creativity neither can be learned as a skill nor technically trained but can be experienced under the right circumstances: "When it comes to developing creativity as a dialogic ability, however, learning depends on the possibility to learn through experience and participation in creative, dialogic and open-minded communities of learning practices" (Krill, 2013, p. 5).

As adults we take part in many different groups and we may have different roles in those groups. Often our participation and experiences are relatively unconscious, but nevertheless the groups form us and nourish us as humans (Nielsen & Sørensen, 2013). When the students form a group to work with PBL, they not only set out to learn about relevant topics and find adequate solutions to real-life problems - they also begin a group process, and their possibilities of creating new knowledge and experience transformative learning are connected to the dynamics and the process of the group. Foulkes (1948), who is well-known within group-analytic psychotherapy, pointed out that we cannot separate the individual from the group - they go together, like a figure-and-ground constellation: "each individual - itself an artificial, though plausible, abstraction - is basically and centrally determined, inevitably, by the world in which he lives, by the community, the group, of which he forms part" (Foulkes, 1948/1983, p. 10). Foulkes created the concept 'group matrix' as related to the origin or maternal forces of the group and described it as a psychological network in which all the individual and collective processes meet and interact. He also used several musical terms to describe the group processes, i.e. the role of the therapist as a 'conductor', and the 'resonance' of the group (Foulkes, 1977). Resonance phenomena occur with all types of vibrations or waves, and they occur when a system is met or affected by a frequency that matches one of its own natural frequencies. Thus the concept of resonance implies two systems relating to each

other. Resonance is also a social phenomenon, as for example most people have tried to sense an emotional atmosphere from another person or in a specific social context (Lindvang, 2010; Thygesen, 2005). This kind of nonverbal feeling of or attunement to each other is probably rooted in the so called mirror neurons, which are cells in the brain that gets activated when we see other peoples' actions as if we did the action ourselves or when we feel the same feeling as the other person feels (Gallese & Goldman 1998; Rizzolatti & Arbib 1998 in Stern, 2004). Frustration and tensions may, as well as positive feelings, be vehicles that initiate new reflections raising the learning to a creative level. In musical terms the interaction between harmonic and dissonant phrases may build a more interesting, moving and engaging soundscape than harmonious chords with no tension would do alone. But it is crucial that the group develops a reflexive milieu. Following Helenius (1990) such a milieu must contain several elements: 1) A wish to be a part of a group and undergo a shared development through a mentalizing dialogue where each member views his or her own approach in the light of others' 2) A wish to present and share one's own thinking and knowledge and be ready to discuss it. 3) A wish to see things in their complexity and from new perspectives and to exceed habits (Olsen & Pedersen 2009, p. 73). Building a reflexive milieu demands the participants in the group to put themselves at risk and that each one is respectful and responsive to what their peers contribute. This is not always the case and sometimes it is a real challenge to build up enough trust and bring together the differences in the group.

EMOTIONAL ASPECTS OF LEARNING AND PBL PROCESSES

The increased interest in the importance of the emotions in psychology and learning areas has been supported by research within neuroscience. The work of the neurologist Damasio has had a big influence on our understanding of the relationship between the cognitive and the emotional part of the human being. Damasio has in his book 'Descartes' error' (Damasio, 1994) challenged the persistent idea that rationality and emotionality should be separated as independent processes. Descartes famous sentence: cogito ergo sum (I think therefore I am) suggests that our thinking constitutes our being, but Damasio argues the opposite; that we only think because we are, since thinking is caused by and connected to our existence. Damasio found that reason is 'embodied' - based in the human being's physical self and he claims that we need to include the whole organism and the surrounding physical as well as social milieu in order to understand what happens in the brain. Further Damasio holds that personally beneficial decision requires emotion as well as reason (Damasio, 1994; 2000). Generally feelings and knowledge about our feelings can be used constructively in the interaction with people and the world around us. Moreover, the emotional memory is very comprehensive and far reaching which means that learning is facilitated and promoted when emotions and feelings are present in the learning situation. Therefore it is an advantage when the presence of emotions and feelings can be integrated in a balanced way in the PBL group work. During the process the group needs to take many decisions that are complicated

because of the many options and things that need to be taken into consideration and in this process the group needs to listen to their somatic markers - their bodily and emotional signals and reactions. In PBL it is important to be aware about how thinking and feeling are intertwined and that the balance between thinking and feeling influences the communication and the process. For example it may lead to a non-functioning group who misses the qualities of thinking if emotions and feelings dominate excessively as well as reduction and repression of feelings may result in the lack of motivation, vitality and warmth and various social as well as cognitive problems.

Emotional knowledge of each others' lived experience is an intrinsic part of 'learning-in-relationship' (Yorks & Kasl, 2002). It is found that positive emotions extend both social and cognitive functioning and therefore support our ability to learn. Thus it is meaningful to focus on the social aspects of the process and to develop an emotional atmosphere in the PBL group where disagreements and conflicts can be overcome. If a PBL group collaborates successfully it will most likely result in positive emotions such as joy, excitement, love and pride that will strengthen the group and promote self-efficacy, reciprocity and understanding (Rowe, Fitness and Wood, 2015). Later we will point out that music listening can be a possible way to generate positive emotions in the PBL group.

MUSIC, COMMUNICATION AND CREATIVITY

From our background in music therapy the strength of our work as clinicians as well as educators is intimately associated with emotional and creative developmental processes. We draw upon many years of teaching our students through experiential learning and facilitating the students' personal energies, mindfulness, emotions, relationships and group coherence in a bottom-up process of learning.

We would like to introduce one of our main methods: music improvisation, as a way to further elaborate on the creative processes in PBL. In line with what we mentioned earlier, creative processes can be described as third order knowledge, characterized by dedication and absence of control. In the music improvisation the participants do not control what will happen, they open up their mind and they follow the music as it appears. There are many different methods of music improvisation, but generally it can be defined as "the art of spontaneous creating music… while playing, rather than performing a composition already written" (Bruscia, 1987, p. 5). A general rule in music therapy improvisation is that the music is heard as an analogy of the internal state of the player, and/or the intersubjective relationship in the dyad or the group (Smeijsters, 2005). In a musical improvisation, as in a PBL project, an interplay takes place between the past (culture, skills, preferences, past events) and the present (mood, interest, life situation). When improvising or playing together musically in music therapy, all sounds are regarded as musical and communicative, and there is no

preferred style or genre (Bonde, 2015). A 'playing space' is formed as a space of action, also called a "multilayered and many-roomed container" (Wigram, 2004, p. 43), where one can work with a wide range of feelings, conflicts and psychological patterns. Comparing a music improvisation with the meeting in a PBL group, the discussion can display a very slow tempo with low pitched voices, or it can be a quick and frantic discussion where everybody is talking at the same time. There can be a free flowing inspiration or blocked energy, both will be audible in the musical language of the voices. The PBL group may ask itself; how do we play together or how is our music today - to create self-awareness and self-reflectivity - that are important components in the creative third order level of learning.

In a group of musical improvisers different instruments and different roles can be tried out. To avoid that the same group member always plays the same instrument, and has the same position and task in the group, it can be agreed to change instrument, position and task. In a PBL group work the analogy would be that the group agrees to circulate the different roles and tasks. For example the roles of being the moderator or the secretary in the group discussion, the one who is structuring today's agenda or keeping the time structure in group discussions etc. may be changed in order to create movement and flexibility in the group.

The depth of listening to each other predetermines the spontaneous flow of new thoughts in the group dialogues. Both in the improvising and in the group discussion it is through the act of listening that we can open up to the yet unknown, and to the inner realities and creative thinking of other human beings. After an improvisation it often happens that the participants are surprised about the others' inner experiences. In a PBL discussion it is conducive to create space for curiosity, wonder and surprise as well.

When working with group dynamics through music improvisation, the group-leader or 'conductor' may suggest that the group follows the "playrule": 'tutti, duo, tutti', which means that first the whole group improvises, then only two participants improvise, and in the end everyone goes together again. The playrule enhances concentration and listening. This playrule may very well function in a PBL group as well: in the first phase the whole group enters a discussion, followed by a phase with discussion between only two members while the others are listening, and then in the end the discussion is opened up to the whole group again. In principle there are numerous variations of this playrule, which corresponds to different models of reflective teams. A playrule gives a structure or form that is momentarily guiding the group work and it may help to keep the group cooperating in a constructive way. A 'playrule' can also be used to create changes in the way the group members communicate with each other or to solve a crisis in the group. If the members tend to speak all at once it may be helpful to introduce a playrule about turn taking, e.g.; that each member speak for a certain amount of minutes while the others are listening carefully or that each contribution must be followed by a short moment of silence.

Sometimes the music improvisation does not work well: Even if we define that any form of musical expression is accepted, the participants are not really present and they are not truly listening to themselves or the others, and the music is fragmented or disconnected and falls apart. This is also what may happen in a PBL group; the members do not concentrate, they do not listen or express what they think and they do not find a meeting point. If the members seem to be on different wavelengths in a PBL group, it can be an idea to ask the group members to mirror (repeat) each other to check if they have listened well enough and understood each other correctly. Sometimes a PBL group will need a supervisor to facilitate these communicative experiments or to start a reflection about the group members' state of mind, since the members may be too involved to see the patterns at first. We will return to the role of the supervisor in the next section.

It is important to be aware that the interactions between group members have both verbal and nonverbal elements. According to analyses of early interaction and proto-dialogues between newborn infants and their mothers/fathers we are born with an inherent musicality, enabling us to communicate intentions and vitality forms through sound and movements and joyfully share intense moments in what has been called "communicative musicality" (Malloch & Trevarthen, 2009; Stern, 2004). The early musical dialogues consisting of synchronization, turn-taking, and imitation of sounds and facial expressions both serve to regulate stressful feelings in the child, and also to enrich and strengthen the relationship. Communicative musicality has also been called the 'language before language' (Hart, 2006) and underlies later development of spoken language, creativity and social engagement through our whole life. All verbal and nonverbal communication in life has a musical side to it:

> *...the capacity to generate and participate in communicative musicality gives us our ability to be with another person in one texture of time, regardless of age, and allows this time to be shaped into mutually satisfying narratives of interaction through the inflection of vocal and bodily gesture (Trevarthen & Malloch, 2000, p. 6).*

Students carry each their own patterns of communicative musicality into the project group. We argue that this can have a profound significance for the atmosphere, the reflexive milieu and progress of the learning experience. The group can also be a place to train and develop new patterns of interaction along with the project work especially if the supervisor encourages and supports this kind of learning.

THE 'MUSICAL' SUPERVISOR

According to qualitative evaluation of students' satisfaction with supervisors Steinert (2004) found that students highly emphasize group atmosphere and facilitation skills, and Kassab et al. (2006) showed that students value those who establish good communications with

students, understand their feelings and advise students on how to learn. This shows that even though PBL is a learner-centered approach, the supervisor still has an important role to play (Savery, 2006). Both experienced and new learners may need sensitive communication and empathy when struggling with insecurity and vulnerability that accompany many truly creative and groundbreaking projects. This can be linked to the early regulation as described in communicative musicality, where the task is to contain and regulate the stress level, to motivate and empower the students by interacting with them in a sensitive and supportive way and by helping them in difficult situations. The supervisor is also a kind of role model: if the supervisor acts with respect and sensitivity there is a chance that the group will take over this kind of attitude. If he or she is a good listener the students will probably develop the sense of listening to each other during the process.

If we use Foulkes' concept of 'conductor', the group supervisor is a person who listens to the group from the outside. The conducting supervisor intervenes without becoming a group leader who takes over and does all the work. He or she facilitates safety as well as curiosity in the group, if necessary points out possible directions to go, safeguards that each person (or instrument of the orchestra) takes part and is heard, and supports that the group as a whole dares to follow its own ideas and visions and share the responsibilities of the work. Further the concept of the supervisor as a conductor implies that he or she is less needed when the group works well on the tasks, in musical terms when the group has found its own style and the music plays with its own rhythm and melody. The use of the metaphor of 'conductor' may also have its limits in this context - unless we talk about a conductor who tolerates chaos and unpolished or unfinished sound making along the process.

According to Olsen and Pedersen (2009) a well-functioning group will use the supervisor as a 'resonance box'. He or she focuses on the process, discusses, asks questions and facilitates reflection, but leaves the choices and the responsibility of the final result to the group. Following our terminology in the present paper this means that the supervisor grasps the sounds of the group and understands them well enough to be able to amplify, enhance or deepen the sound, in order to facilitate that the group's work will be as nuanced, clear and creative as possible.

Olsen and Pedersen (2009) point out that it is a part of PBL to be able as a group to handle conflicts with the supervisor. Often the problem will be that the roles and the mutual expectations between the supervisor and the group are not attuned. According to neuroaffective research conflicts and misattunement are possibilities to learn and grow from but only when the misunderstandings are repaired (Hart, 2006; 2008). In the task of supporting the group to embark on the creative journey it would be easy for the supervisor to ask the students to follow a well-known route, related to his or her own ideas, experiences, theoretical stances etc. - but the supervisor needs continuous self-awareness in order to be an open minded facilitator of creativity in each group. The process demands courage, trust,

playfulness and the ability to run a risk, not only on the part of the learner but also on the part of the supervisor.

CREATIVITY AND MUSIC LISTENING

Now we will turn to the last part of the paper and focus on music listening as a concrete intervention in the PBL process. To substantiate the reason for suggesting music listening we will elaborate a bit more on the concept of creativity and the connection to neurobiological theory, and further we present a few relevant research results that support the benefits of music listening in a PBL group.

The Hungarian philosopher Arthur Koestler (1964) stated that we are creative when we create a new whole from something that was not related until then. We become 'bisociative', which means that we combine different ways of thinking from different levels of consciousness. Our normal state of consciousness contains restricted amount of information and the transport of information is slow, and therefore we benefit from expansion of our consciousness (Vedfelt, 2000; 2007). According to Koestler, creativity will often appear where language stops – the source of creativity lies outside our everyday state of consciousness: "Creativity emerges when we allow ourselves to change space and see the world from this new space. A visit in an unaccustomed space makes our horizon change character and width" (Olsen, J.B., 1999, p. 42, our translation). Listening to music may open to a state of consciousness that is different from our everyday state, it is another kind of space where our minds can meet in a new way.

The oscillation between different levels of consciousness has been described and measured by research in brain waves: Cognitive processing, emotional engagement and attention in daily life have been related to beta rhythm (14-60 Hz) whereas alpha rhythm (8-13 Hz) corresponds to rest with closed eyes and might be related to daydreaming and light meditative states (Hart, 2008). Prolonged beta states correspond to stress, and different kinds of relaxation exercises and music listening help to tone down beta states and go into alpha states (Bonde, 2009). Following Hermansen (2006) it is wise to pause and let the mind have a 'mental field walk' now and then, corresponding to a momentary day dream (alpha waves), if you want to keep the 'window of opportunity' open and learn new things. And for a team it is very important to agree on how to move into a lower gear when it is needed, or else people will lose the feeling of themselves as well as of the others (Hermansen, 2006). Thus the search for movement between different levels of consciousness will support creativity as well as social cohesion.

The PBL group needs to enhance the social engagement, the ability to concentrate, the creativity and the ability to manage stress. The following research results about music listening seem to give answer to the many challenges of the PBL group work: Listening to music often brings people together in the here and now (Bonde, 2009), regulates emotions and relieves stress (Beck, 2012; Helsing, 2012; Juslin & Sloboda, 2010). Music listening in work settings has enhanced concentration and creative problem solving (Lesiuk, 2005). New

research has shown that music activates pathways in the whole brain. Furthermore, activating the auditory system music also engages almost all other neural systems and cognitive functions such as memory, motoric, multi-sensory, attentional and emotional pathways (Altenmüller & Schlaug, 2012; Kraus, Strait & Zatorre, 2014). A recent review of 400 studies of the effect of music on the brain concluded that music improves well-being and health by activating four systems of neurochemicals related to reward and pleasure, stress reduction, enhanced function of immune system and social attachment (Chanda & Levitin, 2013). Music listening combined with guided or spontaneous imagery further increases access to creativity, coping with stress and improved quality of life (Beck, 2012; Grocke & Wigram, 2007). It is also found that there is a correlation between psychophysical health and the ability to manage loneliness and aggression among students who listen to music (Thoma, Scholz, Ehlert, & Nater, 2012).

MUSIC LISTENING INTERVENTION IN PBL

We would like to contribute to the efforts of developing the PBL work in a creative direction with our model of 'music listening intervention' to be used by any group or supervisor for whom these suggestions matches. Basically we think of the listening intervention as a self-helping tool for the group. In PBL it is important that the group takes responsibility and learn how it can optimize the group creativity by its own power. But as mentioned above, sometimes groups need a supervisor to help the group in the right direction, to inspire and find resources.

In the following we present selected music listening methods related to the three areas which we have touched on in the present paper: 'energy regulation', 'group cohesion' and 'flexible consciousness' with a short description of aims and practical use in the PBL group and illustrated by selected vignettes created from our PBL experiences and students' portfolios as well as from our experiences with music listening in other contexts. This section will also serve as a summing up some of our points from earlier sections.

Music is an accessible tool - today most young people carry their music with them every day on their mobile phone or I-pod, and they can easily download new pieces and share their music. It is important to notice that music can affect us in quite different ways, and it will be a creative process in itself that the group and/or the supervisor tries to collect the usable music and stay open to each group member's experiences.

MUSIC LISTENING AND REGULATION OF ENERGY

When: The music listening is used to either support relaxation and thereby reduce the level of stress and tension in a group or to lift up the energy in a group who has difficulties in progressing, is tired or works too slowly.

Why: Most people have experience in listening to music in their everyday life. A very basic capacity of music is to regulate our energy; music affects our nervous system, which generally means that we get either more awake, energized, aware or even alert when the sympathetic part is activated, or we slow down and get more calm, relaxed and reassured when the parasympathetic part of the nervous system is activated (MacDonald, Kreutz & Mitchell, 2013).

How: The group members agree that they need either to lower the level of stress and calm down or they need to lift up their energy. In the first case the group members place themselves comfortably, possibly lie down, and before the chosen music begins they spend a few minutes on focusing on their own breath. The music should be characterized by a slow tempo, and be harmonious, tranquil and predictable.

Case vignette:
A group of four young female students in a PBL group all had difficulties of changing from their well-known way of writing projects to a problem based focus, and they experienced doubt and insecurity. The supervisor suggested that the group used music to reduce their stress level and focus inwards to find some strength, and all of the four listened to Hoppé: "Lavender shadows" sitting on the chairs. Afterwards the students felt they could breathe deeper, and that their minds were clearer. Other music pieces for this purpose could be Bach: "Concert for 2 violins, largo", or Secret Garden: "Dreamcatcher".

In case the group uses music for increasing the energy the students may need to stand up and start by stretching the body before the music begins. And then they can have a group dance and jump to the music! It is also a possibility to lie down with closed eyes and just imagine the dance while experiencing the music in the body. The music should be characterized by stable pulse and rhythmic clarity, and a dynamic structure with both tension and release.

Case vignette:
A project group with a high degree of diversity regarding age and academic level used music to keep up their energy and unite the group (Brown: "I feel good", Ásgeir: "Torrent", Beatles: "With a little help", Larsen: "Tarzan Mamma Mia", Afrocelt Sound System: Whirly-reel-1" and Bond: "Victory"). In the last phase where they had to pull together the threads and unite the different text parts, the group kept up the courage and motivation by dancing

and doing physical exercises together in the breaks. In their portfolio they wrote: "In our work together we have kept a good tone, but our different working strategies and ways of expressing ourselves obviously have triggered some frustrations. We are very satisfied with the way we have gone through it enabling everybody to learn something each from their own perspective".

Case vignette:
Another project group ended up in a very stressful situation before delivering their project, and they kept awake all night to finish their work before deadline. They were extremely tired and also upset because of worries and they had to keep the spirits up as well as they needed to stay awake. They sat with each their own headphones but they decided to listen to the same music, found the suggested piece of music, and counted down; 3,2,1 - in order to start the music at the same time. Now as they sat by their computers working with different parts of the text, they could see each other moving with the music and the music helped them to overcome the pressure and to stay together in spite of threatening emotions. They listened to Seinabo Sey: "Younger (Kygo Remix)" and Kyla La Grange: "Cut your teeth".

MUSIC LISTENING AND GROUP COHESION

When: If the group acknowledges the potential power of community and group collaboration and wants to empower this inherent capacity in order to strengthen the group cohesion and the creative processes. Or if the group of people find themselves in a situation where each of them feels more or less alone and the communication have partly broken down between them.

Why: Music has the ability to bring peoples' minds and hearts together. Sharing a piece of music may exceed the problems of understanding each other`s way of expression. Music is closely connected to our identity, and specific music can indicate the individual as well as the group identity. Or the music may for a while move the attention away from problems in the group work and open up to new qualities within the group.

How: Each of the group members shares his/her own favorite music with the whole group. The group members listen with respect. After listening to the music the person who selected the piece can explain what he or she likes about it, where it comes from, when he/she listens to it etc., and after that the group can share their experiences in listening but without judging the music as good or bad. A further elaboration could be that the group finds 'the group's favorite music'; music that they all like and hear as fitting the group, and develops one or more group playlists to accompany the group through the journey of PBL.

Case-vignette:

A project group with quite young students coming from different cultural backgrounds was experiencing troublesome phases in their group work due to difficulties in understanding each other's way of thinking. The supervisor noticed that several of the group members often worked with headphones on and she curiously asked what the persons listened to, and if they each would like to share a piece of music that represented themselves and could give some energy to the group. The students chose Iglesias': "One day at a time", Morrison's "Wonderful world", Arctic monkeys: "Snap out of it", van Morrison's "Brown eyed girl" and a song that was presented as the "silly one": "The colours of the wind" from the Disney movie Pocahontas. The group felt good about the music sharing, and thought about using the songs when "waves were a little high" or "it all felt awful" to get into a more happy mood.

Case vignette:

In the midst of a project a group had spare time to meet and discuss and take important decisions because of ongoing health issues regarding two of the group members. The level of frustration was growing. There were at least three major directions for the project to take according to the student´s different interests. In a supervision the idea to take a break and listen to a piece of music emerged (two of the students were musicians). The group members listened to Pachelbel´s:" Canon in D", a classical piece with a firm ground but with some development in the melody. Several of the students felt more at ease and more able to listen to the others after the music break, however, one of the students started to cry and revealed her fear of not being able to make it. The group discussion took a new direction where the care of each of the students became part of the final decision of what direction their project should take.

MUSIC LISTENING TO SUPPORT A FLEXIBILITY OF CONSCIOUSNESS

When: If the group is stuck and seems worn out, if the members have been running in the same groove for too long and are in need of new ideas. Or simply when the well functioning group would like support from the music to get access to their inner creativity for example in order to do an open brainstorm afterwards.

Why: The music listening is used to move the focus of attention and give space, for an oscillation of mind - between fantasizing/reflection and academic work and spaces in between and thereby enhance intuition and innovation in the PBL process. It is a kind of 'timeout' or 'mental field walk' where the consciousness of the individual and of the group gets a chance to expand and go beyond the well-known everyday level. The listener may feel stimulated and new pathways are activated in the brain. Probably the brain waves change from beta to alpha and subconsciously the mind will work with a larger amount of data and thoughts.

How: The group take a break from verbal discussion, sit or lie in a relaxed position and listen to a lyrical piece of music with a fairly slow tempo. The music listening can induce spontaneous inner imagery; visual, emotional, bodily or cognitive. After listening, the students share their inner imagery and how it might reflect the group's working process and ideas.

Case vignette:

During supervision the group was stuck with the problem formulating, where too many perspectives had been raised, and no synthesis had appeared. The supervisor proposed that the group listened to a piece of music (Williams: "Romanza for cello and orchestra") with eyes closed, focusing on inner imagery and body sensations. The symphonic music has a light tone and a lot of movement leading up to a climax. After listening the group members shared their imagery. Two group members had felt the music affect their bodies, and one group member had seen an inner imagery of a big blossoming tree with many branches. The fourth group member thought about going to the beach and playing in the waves. The group chose the blossoming tree as a metaphor for an integration of their many perspectives. After that they were able to write down a problem formulation that everybody agreed on.

Case vignette:

In a PBL group of three students with a high level of reflection and ideas, the group used music to enhance the creativity of their work. In a group meeting, after having discussed their work since last meeting and some of their ideas, they felt a little stuck. They decided to listen to a piece of music to let the mind get a break and try to open up for new inspiration. Lying on the floor they listened to Enya: "Carribean blue, remastered 2009". The group members had worked with the creation of a new model, and during the music listening one of the students saw an image of himself moving up a curving road that lead him to see the model in three dimensions, allowing more aspects to be integrated. The other group members were happy about the breakthrough, and the work continued with lots of ambiance.

DISCUSSION

In this paper we have presented PBL as a social musical journey by using the analogy between the music group who improvises and the PBL group in their progressing work. We found inspiration in the analogy in terms of thinking creatively about the project work and the resources as well as challenges that lie in the group work. The limit of this analogy is, that the improvising group usually does not have to work towards an end product - the group can dwell in music making; the listening and in the interacting in the here-and-now. The PBL group needs to balance process and product, and it is important that the devotion to the creative aspects of the process does not overrule the common goal of delivering a high-level product. Secondly we have pointed out the possibility of using music listening in order to

change and develop the way a PBL group is working together. It is our experience that listening to the same music together fosters relationship and opens a door to shared emotions and creativity. But music is not a miracle cure for a bad functioning group with a lack of engagement. When the group members are engaged and willing to experiment, listening to music together can regulate energy, develop listening skills and group cohesion as well as open up to new thoughts and ideas, and the participants will become better 'PBL-players'. But too much music listening without a clear focus or task connected to it, may lead the group away from the track; it is a question of timing and of hold and release in the right proportions. It is also a remaining question if a supervisor with no specific experience in group dynamics or music listening will be able to use the model of music listening. It should be mentioned that we are in an early stage of our research in this area. With more research and feedback from students and supervisors we will develop the model.

CONCLUSION

Creativity, defined as a dialogic ability, is related to a high reflexive level and open-mindedness in the PBL group. To enhance the creativity in project based learning processes, we suggest an increased focus on the musicality of the group; the group dynamics, emotional containment and sharing of emotions as well as the attuned communication between group members. We suggest that the supervisor balances the academic training and theorizing with a supportive attitude towards the social development of the group. Music listening as an aesthetic supplement could serve as a way to stimulate the creativity, develop group cohesion and facilitate energy regulation. Music and musicality plays a vital role in creating and sustaining human social relationships and the relational and potential becoming of the human being as a whole is an opportunity in problem based learning in groups. We hope that musical and social competencies together with the ability to participate in innovative problem solving obtained in PBL work can be transferred to a sustainable and social way of participation in the working communities in our society.

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Hidden realities inside PBL design processes: Is consensus design an impossible clash of interest between the individual and the collective, and is architecture its first victim?

Ole Pihl *

ABSTRACT

How do architecture students experience the contradictions between the individual and the group at the Department of Architecture and Design of Aalborg University? The Problem-Based Learning model has been extensively applied to the department's degree programs in coherence with the Integrated Design Process, but is a group-based architecture and design education better than that which is individually based? How does PBL affect space, form, and creative processes?

Hans Kiib, professor and one of the founders of the Department of Architecture and Design in Aalborg, describes his intentions for the education as being intuition, reflection, artistic progression and critical interpretation (Kiib 2004). "As the reflection and critical interpretation are well integrated within the education, mostly parts of the exam evaluation, it seems like the artistic progression and intuition are somewhat drowning within the group work, as it is closer related to the actual PBL process". Is the Integrated Design Process (Knudstrup 2004) and is Colb (1975) still current and valid? Can we still use these methodologies when we must create "learning for an unknown future," as Ronald Barnett (2004) claims that we are passing from a complex world into one based on super complexity? Could Gaston Bachelard (1958), who writes in his book The Poetic of Space "that poets and artists are born phenomenologists," help architecture and design students in their journey to find his/her own professional expression?

This paper investigates the creative processes of the collective and the individual and clarifies some of the hidden realities behind the PBL-based creative processes, both through an inquiry with the students and a more methodological and theoretical approach. The paper also explores how to integrate artistic progression and intuition within group work by investigating a group of concrete project cases from the Department of Architecture and Design based upon the following points:

1) How can a PBL group-based learning environment based on a dialogical consensus ensure that everyone is working towards the same goal?
2) Does consensus architecture secure a necessary analysis and interpretation of the context, or does it create a grey consensus architecture based on compromises?

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3) Does the PBL-method evoke a certain expression in space, form and materiality, but perhaps exclude other (possibly better) solutions?
4) Every group's work depends on the interplay between the personalities of the individuals and the group. How does this interplay affect the creative process?

This paper seeks answers to the initial question "Is consensus design an impossible clash of interest between the individual and the collective, and is architecture its first victim?" and suggests new possible methodological tools for the architectural design process that secure the level of quality in design education.

Keywords: PBL, design process, flow and conflict, intuition, innovation, and experiment.

THE BLANK PAPER: REFLECTION AND BIAS – IN ACTION

The following cases are based on my work as supervisor and as a semester coordinator for our 1. Sem. At Architecture and Design at Aalborg University and it is based on all my activities with the students during the semester both written text in their semester reports and process evaluation reports, and the verbal dialogue, supervision, examination, and semester evaluations meetings. To each group meeting and supervision has a written agenda and the whole process is documented in text, images and physical models at the final examination. Each semester is a beginning from scratch where we together with the students begin a journey into the hart of the design process both the individual and the collective.

When the students start their first semester most have no knowledge or understanding of the design process and their academic vocabulary is very small. They think and speak very differently from more advanced students and they do not always understand what their supervisor says.

Their ignorance is expressed in many ways, like when they are asked to create a perspective drawing of a place or a house in an urban setting. A common problem at this stage is that they often create their drawings as if they were flying eight meters above the house or house, but they are actually sitting on the ground and sketching at eye level. They simply do not understand how a perspective drawing is done, where the horizon is, or where perspective point are.

They do not even see what is in front of them; it is as if they were temporarily blinded. As beginners, they have common unspoken idea based on their naive bias or a vernacular aesthetic, which is typical for amateurs and nonprofessionals.

The students do not look at the site and the world when they draw. They look at their drawing and draw as they imagine how the world looks, as if in a dream. In reality, they are sitting in a daydream and do not look at the "reality"; they think that they know it in advance, and do not need to look more closely. Their visual language (vocabulary) is small and naïve until they get into a dialogue with the supervisor about the drawing, draw together, and create the horizontal line and perspective points. Then they say, "Oh yes of course." It is in the design process with the new students that we find words through a common experience in both drawing and making working models. The student shows me a drawing and I say, "Try this way" and he/she draws it to see what I think. Together we "reflect – in – action" through drawing; we discover how the design process is a journey and an experiment that constantly provides one with new options.

The image and the drawing is essential, not only when the supervisor and the student draw/work together but also when the students try to explain something through a drawing in order to find a solution to a design problem. The design process and the language are carried by the images when we cannot use words, which are not always enough. There must be a match between pictures and text so that they can support each other and create a synthesis.
But there is no point in learning to construct a perspective sketch if you cannot forget it, it is just an invisible constructed grid behind the image you see, and you must see trough that and beyond.

FOUR CASES ON THE EDGE OF CONSENSUS AESTHETICS - IS ARCHITECTURE THE FIRST VICTIM OF CONSENSUS?

We turn now to four cases of first semester student projects that centered on the minimal housing theme. All are cases where the clash between the individual and the collective ended up differently, some where the lack of consensus destroyed the project, and some where form, function, concept and aesthetic made it a success. Of greatest interest are the cases that was a failure and why they went wrong, a rare example is the group that reflected and improved on the project after they took their exam, which was unusual. Normally the exam is the definitive end of the project due to the tight schedule of the academic calendar, which leaves little time to hesitate and reflect further on one's work.

The students' task that semester was to create a colony of small harbor houses. The project was described as follows:

In the project module, the student should individually prepare a conceptual design of a harbor house and, together with the project, assemble buildings in a colony of harbor houses. Project module consists of two parts that must be resolved coherently - the design of a harbor house (to be done individually) and the design of a colony of harbor houses (which is solved in the project). During the project module, the project team work with their port houses from a specific context, which is one of the two selected land at "Vestre Marina". Within this defined area, the project team develop a construction plan, which then will form the basis of each student design a separate proposal for a 'harbor house'. The 'harbor house' must be contextually relate to the other group members design and form a small colony of 'port houses'. There will also be a special focus on the space between the small port houses, squares, passages, public versus private, etc. (BSc01 2013 studieplan p.68)

The four groups we examine in this paper are:

 1. "Shantytown" - When the group cannot decide and agree on a concept and a set of "design parameters", the few parameters drown in the diversity of the settlement and the project ends up in chaos.

2. "The orangery" - The design concept was so strong and the design parameter was so precise that form and function created a synthesis. Here all the individual houses had to be the same size, consist of the same materials, and have the same function; together they were part of a big glass house called the orangery. It consisted of seven small minimalistic wooden houses for seven botanists, which was a very nostalgic and sympatric concept.

3. "Hexagon square" - A case, based on three group members, that was very strong in concept design, technical drawings and 3D visualization. This was also a very strong concept in form materials and function but was still three individually designed houses based on the users' demand and profession.

4. "Seven pyramid stumps" – In this case, the group agreed on a strong concept but the concept was so strong that it overruled the needs of the users and became a form for form's sake; in other words, it became a project where the user was secondary in importance. However, after the exam the students developed it further by putting it through a new loop of design that focused on the users.

The first three groups completed the project with their exam, which is normal, given the tight curriculum. Only group 4 - "seven pyramid stumps" - was able and willing to take the project through a new loop after the exam.

First we must discuss the phenomenological, pedagogical and methodological aspects of the flow of the semester. The phenomenologist Gaston Bachelard explains the spiritual aspects of the design process the PBL methodology is a fundamental tool for us as architects and designers to transform the phenomenological experience into real design. But there is no safe way to for us. Ronald Barnett claims that our schools and universities are passing from a complex world to a world based on super complexity; here everything is uncertain, fluid, and unknown we will look into that later, first we look into the intuitive part of the design process.

FIRST, YOU MUST LEARN AND THEN YOU MUST LEARN TO FORGET

First, you must learn, and then you must learn to forget what you have learned. "Take a walk on the wild side", you must be free to experiment and trust your own senses; the university should not create uniformity but rather a multiplicity of possible perspective and interpretations of a constantly changing and super complex world. We all need to find our own "voices" or personal approach to the world.

Most of us do not think of the world as constructed, we see it in the same way as the medieval icon painters who painted a world without perspective as flat 2D images. It was not until the Renaissance that artists and architects such as Filippo Brunelleschi and Leonardo da Vinci figured out how to construct a central perspective based on hard work and myriad experiments.

Does this mean that we have a medieval world view? Perhaps, but it is essential that we view the world in more than one way so that we can change optics or position; so that we can see from several perspective points at the same time; and so that we can see the world as a whole. Cezanne, who was one of the first Cubist painters, described his working method in this way:

"The landscape thinks itself in me, and I am its consciousness" (Kearney, R 1994).

Picasso and Braque followed Cezanne's rebellion and worked on their analytical cubism between 1909 and 1912, painting portraits and pictures of Paris based on simultaneous and different perspective points, so that the images contained several layers of view of the same place seen from different perspectives. At first glance, it seemed as though their pictures were flat abstract images; that they had created a "frontality", that stops you from experience the classical perspective you are used to with one horizontal line and a simple perspective point. However, if you stood long enough in front of one of their paintings and immersed yourself in

the picture, you could suddenly see the same thing from several sides at the same time; in other words, you could see all layers simultaneously.

This was a revolution against the classic Renaissance subordinate linear perspective, which immediately revealed everything to the viewer. What we need is to be able to move freely between and work with medieval iconic 2D faces, the 3D images of the Renaissance linear perspective, and the analytical cubist images based on simultaneous perspective points.

Gaston Bachelard stated: "Imagination is always considered to be the faculty of forming images. But it is rather the faculty of deforming the images offered by perception, of freeing ourselves from the immediate images; it is especially the faculty of *changing images.* If there is not a changing of images, an unexpected union of images, there is no imagination, no imaginative action." Imagination is a place of solitude and connection with the world; it has a poetic language of its own where reverie becomes real, where 'poetry nourishes within us reveries which we have not been able to express.*'* (Bachelard 1960 p.159) According to Bachelard, we can deconstruct and break down the world into new multilayered pictures as Picasso and Braque did, and we must do as Jean Lescure says: "Learn and then forget all simultaneously". (*Lescure, J. Lapicque, Galanis, Paris, 123. 1956).* Cities are chaotic kaleidoscopic collages imbued with a sense of life, space, sound, images, tastes, smells and events; cities are moving images. The city is simultaneous film in transparent pictures, layers of different views, and perspective points. Our life is an experiment and experience gained only through aesthetic interaction, as Herbert Read (1956 p. 192) says in his book "Education through Art": "The progressive apprehension of, and comprehension of our environment, is only possible by means of aesthetic patterns. Experience only falls into *artistic shape.* Consciousness is only socially integrated in the degree that it is an aesthetic appreciation of reality."

BACHELARD AND "THE POETICS OF SPACE", A METHODOLOGY FOR THE INTUITIVE DESIGN PROCESS

> My eyes already touch the sunny hill,
> going far ahead of the road I have begun.
> So we are grasped by what we cannot grasp;
> it has its inner light, even from a distance –
> and changes us, even if we do not reach it,
> into something else, which, hardly sensing it,
> we already are;
> a gesture waves us on, answering our own
> wave ...
> but what we feel is the wind in our faces.

"The Walk" by Rainer Maria Rilke (1924)

French philosopher and phenomenologist Gaston Bachelard writes in his book The Poetics of Space "that poets and artists are born phenomenologists" (Bachelard 1958 p. xxviii) but how do we describe an architecture and design student's journey to find himself and his own voice? Can you learn to be a phenomenologist?

To Bachelard the house is the center, the vessel and space that carry our memories in his "La Poétique de l' space" he describes it in the context of our ability to daydream, through numerous examples of poets/artists interpreting poetry and stories. In the book, he examines a phenomenon he calls "the happy room", the room where we yearn and love, the poetic space he calls "Topophilia" (from the Greek 'topos', meaning place, and 'philia', meaning love), meaning to have love and affection for a particular place as part of our cultural identity and sense of where we belong. In Austria, Switzerland and Germany the word "Heimat " is reminiscent of the English word "Homeland". "Heimat" was abused by the Nazis in their attempt to create a special pure Aryan space, place and landscape. Together with "Blut und Boden" ("blood and soil"), another of their slogans, they used "Heimat" to remind us what our origin, homeland and identity is based on.

Bachelard takes a psychological point of view when examining the ideas, images, words and metaphors we use to describe the intimate poetic of feeling at home. In a number of his books ("Water and Dreams", 1942; "The Psychoanalysis of Fire", 1937; and "Air and Dreams", 1943), he describes and analyzes the poetic space as part of his great phenomenological project, our relationship to landscape, dreams and the four elements – water, fire, earth and air. However, "The Poetics of Space" 1958 is in many ways a summary of his studies, philosophical reflections, and phenomenological method.

Bachelard asks, "how can secret rooms, rooms that have disappeared, become abodes for an unforgettable past?" (Bachelard 1958 p. 6) How can it be that we in our daydreams creates spaces that do not exist, that we attach more importance to than the spaces and places that actually exist? Our commemorative space is a major and important construction of our identity and of greater value to us than actual physical space; emotional space has a greater impact than real-world objective space.

Swiss psychiatrist CG Jung described the complex and labyrinthine task psychologists must undertake when describing our psychological space, which, he said, was like the soul of a house:

> We have to describe and to explain a building, the upper story of which
> was erected in the nineteenth century, and a careful examination of the
> masonry discloses the fact that it was reconstructed from a dwelling –
> tower of the eleventh century. In the cellar, we discover Roman

foundation walls, and under the cellar a filled-in cave, in the floor of which stone tools are found and remnants of glacial fauna in the layers below. That would be a sort of picture of our mental structure (Jung 1928 p. 118).

Our soul is a house; our memories and dreams are "living rooms" or places in our house; we have windows, doors, cabinets, drawers and keys to the secret room, word concepts, and metaphors we use when we describe our space of memory and childhood.

House, patch of meadow, oh evening light
Suddenly you acquire an almost human face
You are very near us, embracing and embraced.
Rainer Maria Rilke. Letters 4th *year, Nos. 14-15.16 p. 11*

We console ourselves, as the poet Rainer Marie Rilke did, by reliving memories. They are a protection against oblivion, and give us a sense of possessing an inner personal core, a foundation. Here we keep the images that perhaps slowly change over time. "Topophilia" is not a place but rather a feeling; we are poets who can weave tapestries of an era that never comes back.

"Memories of the outside world will never have the same tonality as those of home and, by recalling these memories, we add to our store of dreams; we are newer real historians, but always near poets, and our emotion is perhaps nothing but an expression of a poetry that was lost" (Bachelard 1958 p.6)

Bachelard believes that by using our poetic imagination we have a methodological opportunity to explore alternative realities. Bachelard's phenomenological method and approach to the world through poetry shows that nothing is stable and that everything is in flux; it is through our imagination and daydreams that we can access an "authentic reality" in the sense of the reality that matters to us. Our daydreams and fantasy are one of the strongest weapons we have and are how we shape and create the world, where the future folds out.

> By the swiftness of its action, the imagination separates us from the past as well as from reality; it faces the future. To the *function of reality*, wise in experience of the past, as it is defined by traditional psychology, should be added a *function of unreality*, which is equally positive. Any weakness in the function of unreality, will hamper the productive psyche. If we cannot imagine, we cannot foreseen (Bachelard 1994.p. xxxiv).

If we cannot imagine or daydream we will not be able to find direction in a chaotic world. Bachelard's phenomenological method describes how our ability to see what is not there is both our operation and foundation, dreams and poetry create the world. The French poet Jean Lescure said that freedom came through art and that it is in the autonomous moments that we find freedom, and it is not enough to be academically trained. "Knowing must therefore be accompanied by an equal capacity to forget knowing. Non-knowing is not a form of ignorance but a difficult transcendence of knowledge. This is the price that must be paid for an oeuvre to be, at all times, a sort of pure beginning, which makes its creation an exercise in freedom" (Lescure p. 78 1956).

In order to achieve freedom and success you should make yourself independent of the skills and knowledge you have. True knowledge and insight come from forgetting everything you have learned, according to Jean Lescure, and using "the function of unreality." Our sense of the unreal, utopic poetry, and other parallel realities are our true core.
"An artist does not create the way he lives, he lives the way he creates."
Jean Lescure Lapicque, Galanis, Paris, p. 123. 1956.

INTRODUCTION TO PBL AND THE CREATIVE PROCESSES

"There is no such thing as a neutral education process. Education either functions as an instrument which is used to facilitate the integration of generations into the logic of the present system and bring about conformity to it, or it becomes the 'practice of freedom', the means by which men and women deal critically with reality and discover how to participate in the transformation of their world."

(Shaull.1999 p.5)

The Aalborg PBL model is a combination of problem-based and project-organized approaches and is based on the old theories of Piaget (1974), Dewey (1933), Lewin (1948) and the new theories proposed by Kolb (1984) Gardner (1993) and Kjærsdam and Enemark (1994). Graff and Kolmos (2003) explained problem-based and project-organized learning in three dimensions, i.e. "*learning is organized around problems*". *Experience learning* is a part of working to solve a problem. The content approach is based on *"inter-disciplinary learning,"* meaning that the solution may span traditional, subject-related boundaries, professions and methods. Finally, "*social learning,*" based on team learning PBL, is also student centered, self-directed ownership of the learning process. Used at Roskilde and Aalborg Universities, PBL is also a product of the so called critical pedagogy, which is based on experience based learning as originally developed by the German critical theorist and philosopher Oscar Negt (1975) and the South American education of peasants formed by Paulo Freire and his "Pedagogy of the Oppressed" (1970). The PBL model also has links to

Maastricht University and Lindköping University, which introduced the same principles during the same time period.
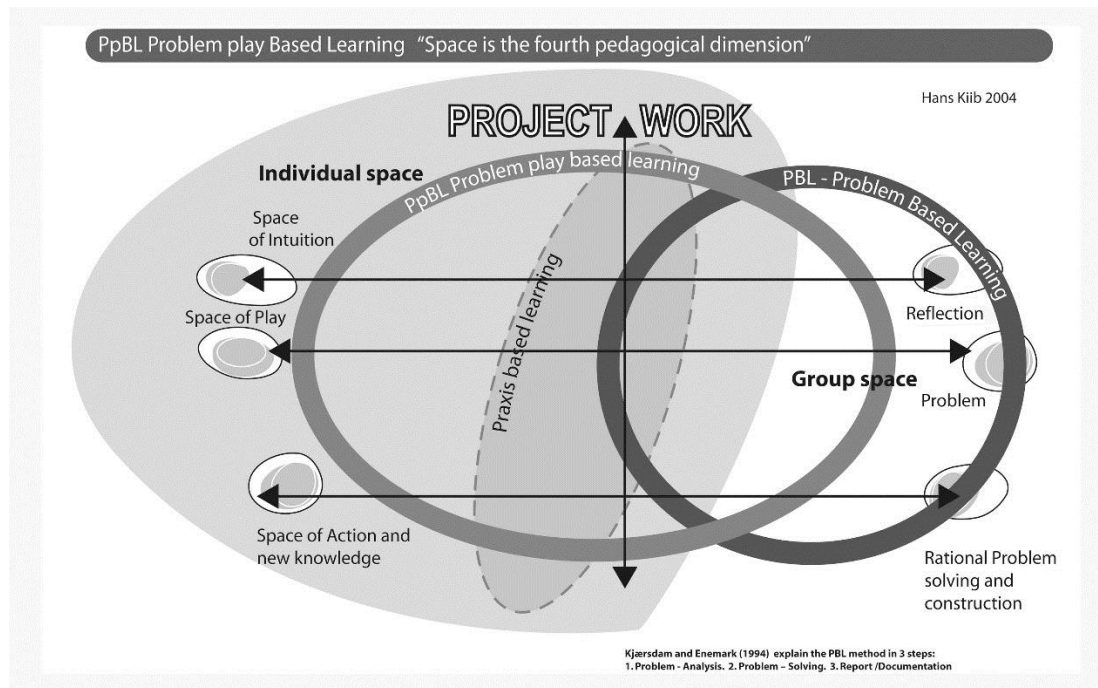
The core of project-organized, problem-based learning is described in the booklet "The Aalborg Experiment Kjærsdam and Enemark" (1994), which explains clearly and simply the principles of the method in three steps on three levels:

Literature - Lectures - Group studies
1. Problem - Analysis
2. Problem - Solving
3. Report/Documentation

Tutorials - Field studies - Experiment
Knudstrup (2004), from AAU's Department of Architecture and Design, explains the complexity of a typical primary project at A&D based on PBL. It contain such aspects as: rules for group work, user profile, function, plans in 2D and 3D, building program, construction principles, climate screen, ventilation, indoor climate, sun and wind conditions, local and national legislation, architectural concepts and volumes, architectural references, and architecture as an aesthetic endeavor. What is not included in the project is what runs the world outside the university as economic and the actual ongoing process with the client and user, who is the real boss. That part of our profession is what the supervisor and teachers try to simulate.

The design should be beautiful and combine form and function but reaching that point requires a combination of creativity, analytical and technical resources, as well as aesthetic qualities based on a strong foundation of technical competences - together with all the above-mentioned aspects. In one word: complexity.

Knudstrup launched her "integrated design process" (IDP) as a method within the PBL process where the students are taught both by architects and engineers based on a simulation. The core of the IDP is based on five PBL steps, and is an extension of the Kjærsdam and Enemark (1994) model:

1. Problem formulation/project idea
2. Analysis phase - site, context, user profile, energy consumption, construction and aim of the programme
3. Sketching phase - concept, construction, user, and function
4. Synthesis phase - all aspects combined: aesthetics, function, construction, and user
5. Presentation phase - 2D, 3D and physical model and visualization

However, while the "Integrated Design Process" is a simulation of reality, it does not integrate real things such as the client, economics, competition, and time and. What the IDP-PBL process lacks in reality it offers in theory and methodology but is IDP really as integrated as Knudstrup claims? What happened before the 2004 invention of "the integrated design process"? How did all the architects and designers practice integrated design without knowing what it was?

If we take a closer look at the realities of PBL and IDP we realize that PBL is based on the spoken and written word, not on images; thus, there is a fundamental contrast between the eye and the intellect. Architecture begins as a daydream that comes to us without words and has long existed outside the world of higher education. Kiib (2004) suggest an experiential and playful way of learning; by introducing Problem play Based Learning (PpBL).

The experiential way of the PpBL focuses on the meaning and function of "space". In this connection, we perceive "space" as "the fourth pedagogical dimension, beyond those of the didactics of professional discipline, the project-based and the problem-play based" (Kiib 2004). This is a beautiful utopia, where everybody are happy and students from all semesters, supervisors and researchers are close in contact. PpBL takes place in rooms with high ceilings and perfect light conditions. Kiib keeps the notion "play" open to a wide range of interpretations, but depends on Kolb's definition of the design process as a loop based on experience and reflection.

Further ahead in this paper we look at a group of actual cases that explain how this loop of experience and reflection works within the PBL system and the problems involved in taking aesthetic decisions as a group. Both Kiib and Knudstrup refer to Kolb and his five levels of learning. Kolb (1975:45) explains in his book "Experiential Learning" how to use the hermeneutic circle and unfold the intuitive sketch process. He also describes how the loop unfolds between experimentation and reflection. Kolb's learning system is based on four main four elements:

- Concrete experience
- Observation of and reflection on that experience
- Formation of abstract concepts based upon the reflection
- Testing of new concepts
- Repeat (the loop continues)
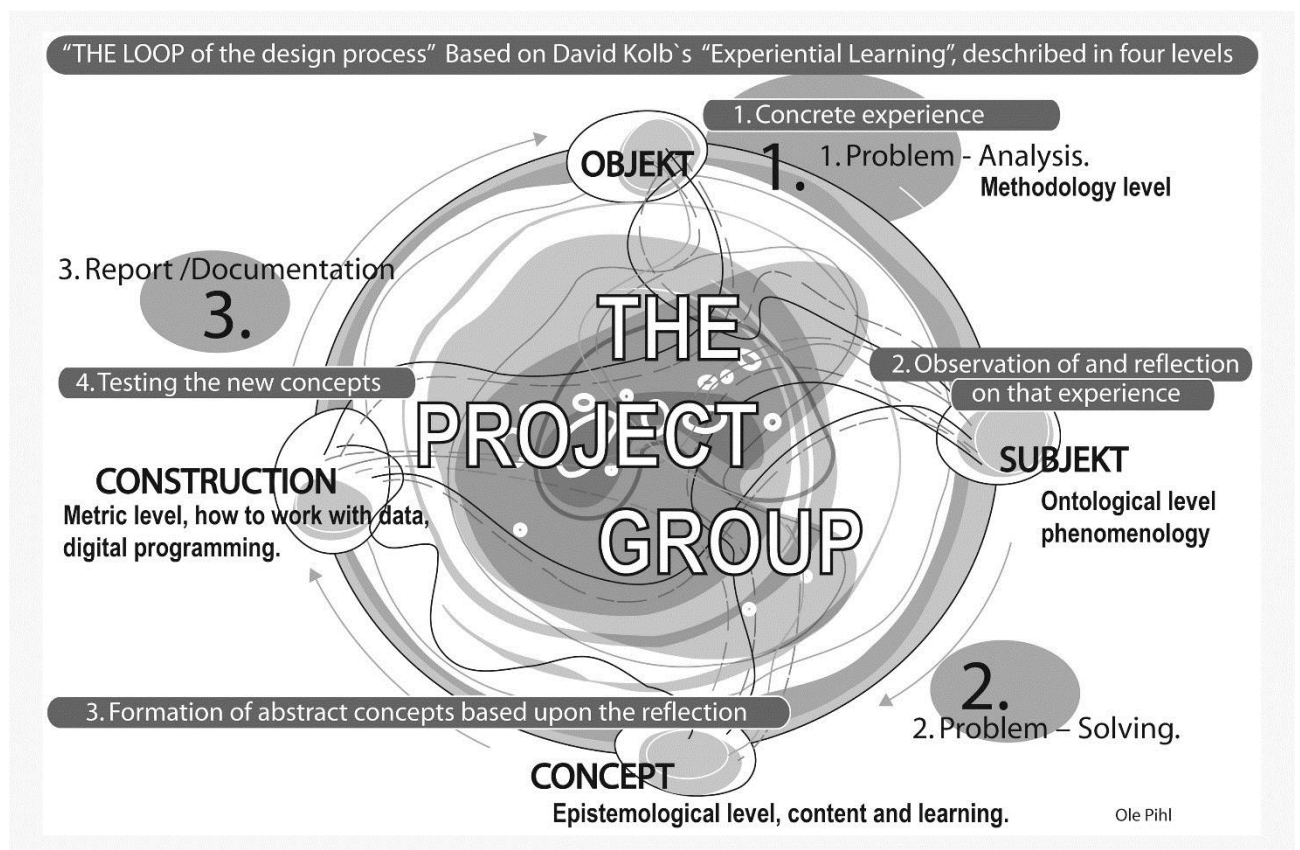
We recognize Kolb's four levels of experience and reflection embedded in the PBL loop: 1. Problem − Analysis. 2. Problem − Solving. 3. Report /Documentation. Furthermore, Kolb (1975) developed four distinct learning styles and explained that we prefer different learning styles because we each have a different motivation and focus that determines how we perceive and learn from our experiences.

According to Kolb, the learning styles are actually the product of two pairs of variables, or aspects that represent the "choices" that we make. As two lines – one vertical and one horizontal placed in a cross – each axis contains a "conflicting" mode at either end: the east-west axis is called the **processing continuum** and refers to how we approach a task, while the north-south axis is called the **perception continuum,** which describes how we think or feel about the task, i.e. our emotional response. The four learning styles are made up of two extrovert styles: **accommodating, diverging**, and two introvert styles: **converging, assimilating**.

The Accommodating (*doing and feeling*) learning style is 'hands-on', and relies on intuition rather than logic. Accommodators prefer to take a practical, experiential approach, and use other people's analysis of a situation or problem. **Divergers** (*feeling and watching*) are people who prefer to work in groups. They are emotional, artistic, and interested in people and culture, .

Convergers (*doing and thinking*) prefer technical tasks and are less concerned with people and interpersonal communication or issues. People with a converging learning style are best at finding practical uses for ideas and theories. They prefer instinct rather than logical analysis and prefer to carry out plans. **Assimilators** (*watching and thinking)* also prefer ideas, logic, and concepts to interpersonal interaction.

Understanding these learning styles helps both students and teachers to make a critical evaluation, of their learning process and develop appropriate learning opportunities. However, critics claim that Kolb's model is too simplistic. Mark Smith, (2001 http://www.infed.org/biblio/b-explrn.htm) for example, points out six problematic points with the model:

1. The model doesn't adequately address the process of reflection.
2. The four learning styles are extravagant.
3. It doesn't sufficiently address the fact of different cultural conditions and experiences.
4. The idea of stages/steps doesn't necessarily match reality.
5. It has only weak empirical evidence.
6. The relationship between learning processes and knowledge is more complex than Kolb draws it.

Like all simple explanations of complex behavior, Kolb's model is aesthetically pleasing but his idea that learning through experience happens in perfect loops between action and reflection is almost too good to be true. Reality is always more unpredictable, unsecure, distorted, and fragmented. (Smith, 2001 p.1) summarizes his critique in the following way:

"The idea of stages or steps does not sit well with the reality of thinking. There is a problem here – that of sequence. As Dewey (1933) has said in relation to reflection a number of processes can occur at once, stages can be jumped. This way of presenting things is rather too neat and is simplistic."

Given these problems we have to be careful how we use Kolb's vision of experiential learning, knowing that he looks more at the individual learning process, than the group and PBL aspects. As Tennant (1997. p. 92) points out, 'the model provides an excellent framework for planning teaching and learning activities and it can be usefully employed as a guide for understanding learning difficulties, vocational counselling, academic advising and so on.' This is in absolute contrast with Paulo Freire's uncompromising approach to education and his strong focus is upon informed, committed action. "No pedagogy which is truly liberating can remain distant from the oppressed by treating them as unfortunates and by presenting for their emulation models from among the oppressors. The oppressed must be their own example in the struggle for their redemption"   (1970. p. 54).

Freire is best known for his attack on what he called the "banking" concept of education, in which the student was viewed as an empty account to be filled by the teacher. He notes that "it transforms students into receiving objects. It attempts to control thinking and action, leads men and women to adjust to the world, and inhibits their creative power" (Freire, 1970, p. 77). We teachers and "oppressors" must also be willing to rethink our way of life and to examine our own role in the oppression if true liberation is to occur; "those who authentically commit themselves to the people must re-examine themselves constantly" (Freire, 1970, p. 60).

Few students who begin their college years today at AAU know anything about Freire and his revolutionary approach to pedagogy but they quickly grasp the social dynamics and advantages that group work gives, including the benefits of social and interdisciplinary learning and self-directed ownership of the learning process. They develop domain dependent skills, technical skills, generic skills, and thinking skills that "domain independent knowledge", such as problem solving techniques and learning strategies. Think of domain independent skills as, general skills that can fit as a problem-solving tool for any profession, in contrast to the more subject specific tools.

LEARNING FOR AN UNKNOWN FUTURE, AND METAPHORICAL DESCRIPTORS

So how do we approach our task of preparing students for the 'real world'? Ronald Barnett claims that we are passing from a complex world to a world based on super complexity; here

everything is uncertain, fluid, and unknown. In this world, according to Barnett, "the idea of skills, even generic skills, is a cul-de-sac." (Barnett, 2004, p. 257) It is a "dead end" to which we need a new approach. "A pedagogy for the uncertainty gains its ultimate achievement when the self is engaged. As we have seen, academics in their teaching role are bringing off this educational aim on a daily basis. Such a pedagogy is to be caught trough metaphorical descriptors." (Barnett, 2004, p. 257) Like Kolb's four learning styles, Barnett's four pedagogical challenges (see Figure X) are placed on two axes, one pole with "educational development" and "educational transformation" at either end and the second axis bounded by "no risk" and "high risk", which creates four boxes, each with a unique pedagogical challenges inside: 1. Disciplinary initiation 2. Disciplinary wonder 3. Generic skills 4. Human being as such.
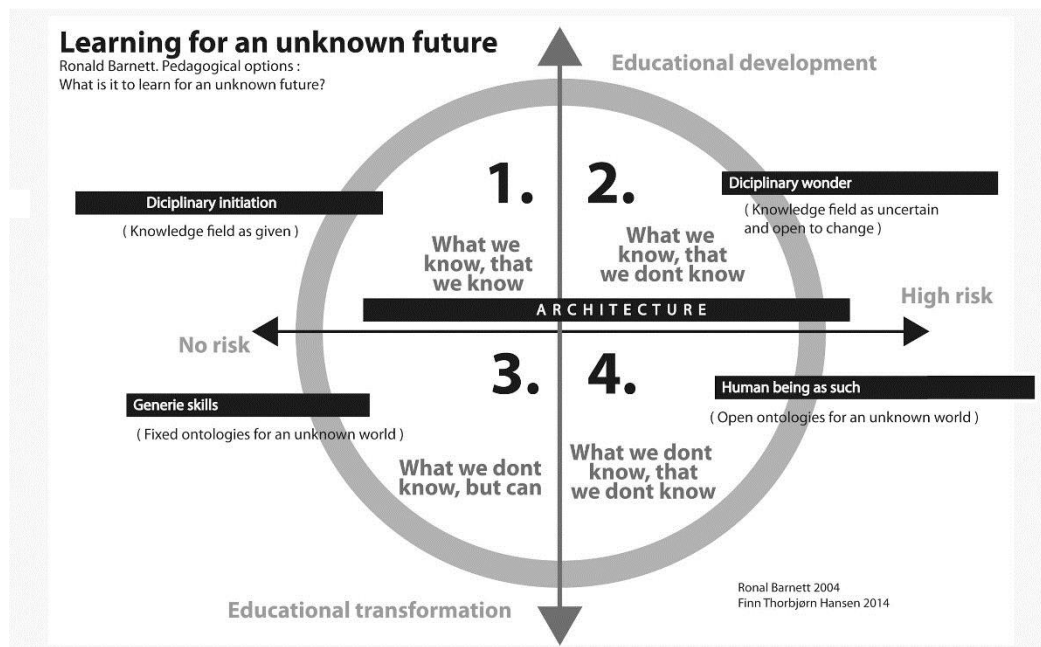
1. Disciplinary initiation: Most higher education programmes, can be understood as offering some form of educational development. The student's growth, in understanding and advancement in skills are relatively risk-free thanks to the specification of aims and objectives and an encouragement to frame curricula according to the requirements of professional bodies. All of this programs, have the latent function of producing curricula that are lacking in risk. Uncertainties are kept to a minimum: this is educational logic at work.

2. Disciplinary wonder: To be fair, academics who take their teaching seriously have long found spaces to do creative and generous work, imaginatively constructing curricula that help to transform students. Where such imaginative teaching takes place, we may even envisage that students are placed in educational situations that are, in a sense, risky.

3. Generic skills: There is an emerging sense that such curricula are inadequate even if they are creative and bring about considerable educational development in students. The learning offered, even by Box 2 curricula, is designed to reproduce academic identities. It is out of such thinking that we have seen t h e d e v e l o p m e n t o f a curricular discourse of 'skills', including 'generic skills'.The paradox of this pedagogy is that it claims to be able to bring students out of their academic domains into forms of being more adequate for a changing world. In short, we are confronted with the nonsensical belief that we can train human beings for uncertainty through a new kind of certainty in the curriculum.

4. Human being as such: The final quadrant offers the possibility and the challenge of a curriculum of high risk. This curriculum is aimed at the transformation of human beings - nothing less. At the same time, it strives to achieve this through pedagogies that are themselves characterized by uncertainty. A pedagogy for uncertainty cannot be (as in Box 3) technological in nature, in which ends and outcomes are tightly specified. A human flourishes here precisely because he/she is living effectively amid uncertainty. At the heart of such a curriculum is an exposure to dilemmas and uncertainties. These may spring from complexities within a field of knowledge (as in Box 2) but they will widen such that the human being him/herself is implicated. What w e n e e d a r e h u m a n s t h a t a r e u p f o r s u c h a c h a l l e n g e.

In his search for a pedagogy to grapple with uncertainty, Barnett speaks of "metaphorical descriptors" as a language for risk, uncertainty, and transformation a t o o l for human beings t h a t facilitate and creates a f r e e m i n d a n d imagination.

> It might be a language of love, of becoming, of disturbance, or of inspiration. What is it for human beings to be encouraged, to be brought forth, out of themselves? Smiles, space, unease, frisson, humanity, empathy, care and engagement may be helpful as descriptors; but each pedagogical situation sets up its own educational challenges and the imagined possibilities will be sensitive to each setting (Barnett 2004).

With his four pedagogical options and challenges, Barnett goes beyond Kolb's model of the design process and learning styles and suggests four different pedagogical scenarios
Box 1: Disciplinary initiation is perhaps the "banking" model as criticized by Paulo Freire.
Box 2: An open pedagogical frame in which the teacher both lectures and teaches the subject. There is a common goal for both students and teachers to share the best interests of the profession.

Barnett calls it a position of "epistemic delight", created by the students as they learn their new profession and become able to use and enjoy the new insights to which the process has opened them. Box 3: Generic skills fit directly into the PBL problem based learning scenario, as we know from Aalborg and Roskilde. In contrast to this, Box 4 is the very open frame where the "risk" and the "epistemic delight" are companions on a wild voyage into the

unknown future. This is actually, what Barnett wants us to do, to "take a walk on the wild side".

CONCLUSION: DYNAMICS BETWEEN GROUP, THE INDIVIDUAL, AND THE ACADEMIC PBL SIMULATION OF THE REAL

So after an intensive semester together with the groups, where do we meet the consensus ghost? We meet it when the students fail to see the perspective and the horizontal line in their drawing, or when they agree on a design for a project based on a political compromise rather than a combination of aesthetics and function. In the beginning of this paper we asked four questions, which we now try to answer in text, images and with a special case report from one of the case groups. To reiterate, here are the four questions:

1) How can a PBL group-based learning environment based on a dialogical consensus ensure that everyone is working towards the same goal?
2) Does consensus architecture secure a necessary analysis and interpretation of the context, or does it create a grey consensus architecture based on compromises?
3) Does the PBL-method evoke a certain expression in space, form and materiality, but perhaps exclude other (possibly better) solutions?
4) Every group's work depends on the interplay between the personalities of the individuals and the group. How does this interplay affect the creative process?

"Shantytown" - Consensus for this group occurred after many long discussions. It took the form of a simple compromise based on three concepts: a submerged square, oblique beams as landscape markers, and the use of round windows as a maritime detail and architectural concept. What led the group's project to end chaos and disorder were the decisions that each house could be designed without any constraints, and that the oblique beams should be scattered randomly around the plot.

This project exposed a major part of the group member's design as primitive vernacular random design such as one experiences in slum areas, in the sense that the that there is no coherence between the houses and an absence of context and architectural design in the final housing. In short, it became an alien shantytown. This is a case in which architecture is the first victim of consensus. While consensus does not necessarily mean high quality, it does mean a compromise all can agree on, so design becomes a matter of creating compromises, similar to politics.

This kind of PBL group dynamic can go both ways. In this case there should have been an intervention by the supervisor. This kind of PBL group work is very fragile and needs a patient advisor who can work with all the individuals on their houses and not just talk *at* the

group members. This case demonstrates why seven first semester students cannot be lumped together and left to their own devices without heavy supervision.

This case also shows that even a bad consensus based design concept cannot damage or obscure the work of two particularly skilled group members, who were craftsmen and created both physical as well as digital models of high quality. The drawings of the work they completed will aid them when they apply for jobs. In conclusion, the skilled students did excellent work while the weak students failed, and the PBL group work and supervision failed to raise the weak students' level of competence and ability.

"The orangery" did not come easily as a concept but through a long series of design loops the group created a disciplined glass house that resembled a cathedral with a monastery off to one side. The concept was simple - a large rectangular orangery with gables placed east to west and seven small houses on the north side, all of which had private access from a boardwalk that also served as a public entrance to the actual orangery. This project actually proves the advantages of the PBL group work when the work is carefully executed with discipline and commitment from all group members. Here consensus created a synthesis of form and function based on a meticulous study of the function and history of winter gardens, orangeries and greenhouses. Group members carried out detailed interviews with professional botanists and gardeners and gave users a high profile and priority. One could argue that the PBL based group work in this case lifted all members to a higher level and left no weak students behind. The supervisor supported the strong project concept and ensured that all the 2D and 3D sketches and models where carefully constructed in terms of scale and materials.

"Hexagon square" was a group of only three members who had a very strong concept in terms of materials and function and three individual designs based on the users' demand and profession. The project was so strong in concept design, technical drawings and 3D visualization that it exceeded the requirements of the project module and semester project description. Because they were so small a group, the members decided to work extra hours and sometimes labored around the clock because they were determined that their project would be the best. There was no aesthetic compromise and the group was quick to make conceptual decisions. The members talked little and had few group discussions but put a lot of work into drawing models and 3D sketches. They produced the same amount of work as groups with seven members because the bigger groups were often slow to make decisions and actually get things done.

The group began as a group of six who could not agree on anything and spent the entire first part of the project on discussions about which way they should go. Finally the supervisor intervened and split the group into two. This group did well but the second small group of three did poorly because two members became ill; they eventually passed the exam with the lowest passing score.

"Seven pyramid stumps" In this case the group agreed on a strong concept in which all seven building units had exactly the same truncated pyramid form. The smallest section of each pyramid pointed to the center square with a spiral staircase that went to a circular roof, which served as a platform with a view of the whole harbor. However, all users - botanists, photographers, and authors - needed to fit into the same structure, which did not work. Each pyramid was a narrow eight-meter high triangular form closed in on all sides save the wide end, which had a large window that was covered with several layers of blinds placed in asymmetric diagonal lines. These lines created a flexible structure that could dampen the sun's light.

The very expressive, partly transparent structure that was based more on a fascination of form than function, but it created an interesting random play of shadow and light. The idea was to mimic the many layers of branches in a forest and the group did a great deal of work sketching, doing models and testing shadows and the interplay between light and dark in complex structures with these abstract representations of branches.

Because the group's form concept was, so strong it was impossible for the project to satisfy the users' needs and desires. However, this problem was not clear to the group before they took their exam and had to explain their project. It was then that they realized that for the project to have a meaning and content, they had to run the design process again keeping the users in mind while also redirecting and redeveloping the architectural and aesthetic expression of the project. The group explained their process in the report below with a storyboard that illustrates the workflow.

WEAKNESS AND ADVANTAGES THE MANY FACES OF CONSENSUS

Looking at these four cases, we can say that a successful PBL pedagogy and group system can lift weak students up to a higher level with the help of strong group members. Seven should be the maximum number of members in any one group and it is up to the group to decide how long to spend on discussions and meetings. However, first semester students have no experience. When groups are small, the project is easier to manage in terms of meetings and discussions, the amount of work per person increases, and weak students cannot hide behind strong students as they can in large groups. Students quickly realize that it is bad for a group to have members they cant trust, there is no demand for the weak or immature students they quickly end up in "weak groups" together in later semesters.

Consensus architecture seems to have many faces as "form for form's sake" in the case of the "seven pyramid stumps" group. Here the group agreed on a strong concept - so strong that it

overruled the needs of the users and became a form for form's sake and a project in which the user was secondary.

"The orangery" was a strong poetic concept with a glass cathedral attached to a monastery in which resided seven botanists in seven small houses. This is the ultimate consequence of a precise design concept; one dwelling totally dominated by function and the user in a giant glass house. A dream garden that survives all season's rages - storms, snow, sun, and rain. Here the face of consensus aesthetics is no compromise but a utopian statement; form function and poetics created unity and an almost metaphysical statement.

In contrast, the "Shantytown" became an example of how the real world works outside academic simulation - this is the dark side of consensus. Architecture and urban design require a complex negotiation between many stakeholders and interests and we must not underestimate the strong political and economic forces that architecture must relate to, and be able to survive, to create something unique for the future and our children. This PBL group work is just a small simulation of the real, and in the Shantytown project it became clear that there is a big difference between the aesthetics of a political compromise and the quality of an individual's work.

Students must agree with their supervisor/mentor that supervision should be both individual and collective. Together they must work with drawings and physical models and share the creative process. Each experiment has to be followed by reflection.
Everyone in the group should also help to share the experience of the individual loops, work toward less talk and more action, and produce a constant flow of drawings, images and models.

We should not underestimate how important it is to explain and demonstrate to new students these examples of the possible consequences of group work and PBL. I will use this paper and the four cases as an introduction for new first semester students.
The ghost of consensus takes the shape of the group it appears in. Consensus is the merciless mirror that reflects our weaknesses and fears as well as our strong sides.

To take a more general view, we have looked at Kolb and Barnett and the two ideals of what a university should represent. But we have also investigated the more individual aspects of the design process explained through Bachelard's "The Poetics of Space" that actually exemplify what Barnett is asking for when he speaks of "metaphorical descriptors", as a new open emancipatory tool and language.

In the architectural design process it is clearly that working with images and both 2D and 3D models it is evident that a metaphorical language can, will and must be developed. However, we must remember that behind the PBL process you can still hear Paulo Freire original voice

telling us that the goal of education is to lead men and women to adjust to the world, and to release their creative power. Thanks to Kolb and his four learning styles, we can also quickly identify some general conflicting personalities and character types that meet and conflict within PBL groups and create a differentiation within the curriculum, and the actual learning process between students and teachers. In plain words, we must and can meet the students where they are. If we don't it is just "the banking method" and who needs that?
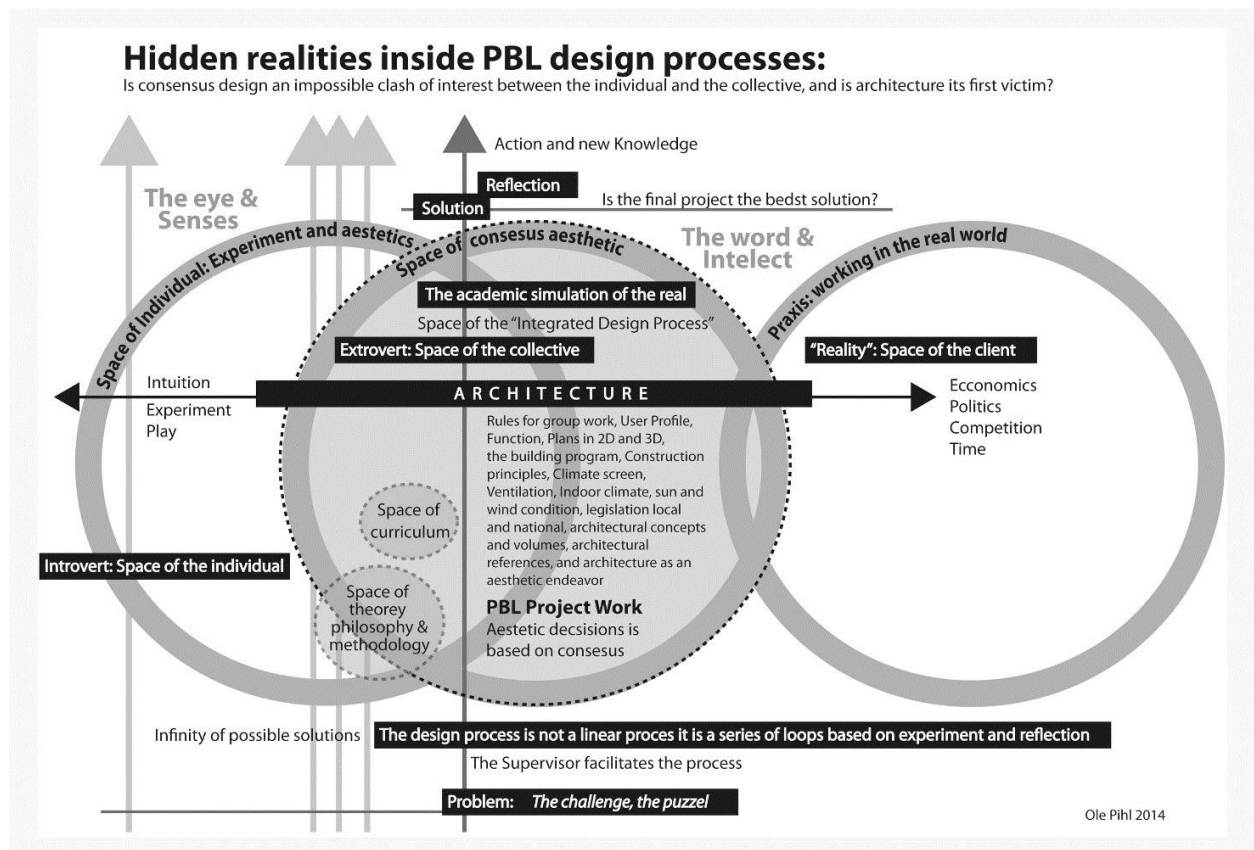
This schema displays "the academic simulation of the real", which is a world of the written and spoken word. There is little space for the visual arts here, and this academic simulation, this extrovert space of the collective has even within itself special hermetic airtight pockets and worlds within worlds as the space of curriculum and of philosophy and theory. Nevertheless, the simulation creates the illusion that it can actually prepare you for an unknown future. In short, as Ronald Barnett stated, "We are confronted in this idea of education with the nonsense belief that we can generate human being for uncertainty through a new kind of certainty in the curriculum".

It must be a warning, like "watch out for the unpredictable future because you do not know which direction it comes from. Prepare for anything."

Assisting students: Tine Brandstrup, Kathrine Virenfeldt Vand, Christoffer Thor Paulsen, Martin Juel Jensen, Mathilde Marie Severinsen, Maria Vittrup Thomsen, Malene Højvælde Nielsen.

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PBL and creative processes: Reflection based on the first semester final project, BSc01 2013. Group b362
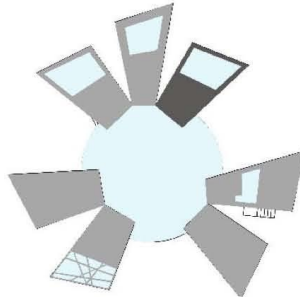
Introduction to the semester theme

First semester final project main theme was "Building and Light". With focus on how public utility integrated into the maritime harbor at the, as an extension of the town - and thereby connect the city and harbor. Furthermore, it was a requirement that had to work in timber structures, as well as to each harbor house had a limitation in scale as a minimal house on max. 60m2. based on this framework, we have created an integrated port colony of seven minimal housing. Each harbor house represents a profile with specific requirements - and individual needs for a port housing. This article does not focus on the actual exam project, but on how the group worked, worked together and utilized each other's skills. The group created a common idiom, which ended up being a distinctive concept. The project where focused on the design and organization of the port houses, but this article focuses on the conceptual reconstruction.

How we experienced the creative processes within the problem-based learning system.

The group used a long time to start the design process. We had many very different ideas for what types of architecture that we could work with as sources of inspiration. In addition, we quickly agreed to gather good ideas through a frame on three themes. It was, cubic, prismatic and organic, and we ended up with a decision for the concept based on a combination of cubic and prismatic design. We concluded to work with the cubic and prismatic forms. These where used for the preparation of two development plans, each consisting of seven individual houses.

Each house was based on selected sources of inspiration, but it was clear to the group that this was not enough to get the optimal interaction between the houses. It was in this part of the process that the group decided to give priority to a strong prismatic concept to the individually houses a concept that overruled the individual aspects of the house and the user.

The group then made a precise conceptual framework for how the houses should look and how the interaction between them would work. The group had many additional factors that were important for creating an optimal port colony combined with public space.

With these elements as stairway platform, gallery, a system of pedestrian paths from the park, the common urban solution was the focus so after much discussion the individual hoses become uniform and alike based on almost same design and size.

Each team member made suggestions for how this form concept should look like. This was pretty far along in the design process, so the group was here began to converge in terms of design. There was not total agreement, but we began to be realized what kind of style the group leaned towards. The individual proposals was therefore not so different from each other at the beginning of the period. However, there was still a need for a vote to conclude which form concept that, should be further developed.

The group agreed that there should be room for individuality. Accommodation and partly facade was therefore up to the individual group member to design. The facade, however, had still some limits to take into account; it would include a specifically designed pattern on the shutters, which should be attached to horizontal larch tree boards, and the harbor houses with artistic residents should have a showcase towards the center of the development plan.

At last we managed to get all the items into a synthesis, creating a strong concept. A concept who can easily afford to have rotated the individual houses, as this coherent idiom creates a red thread. The added elements for public spaces may still be, but must be in line with the houses also rotated and changed.

After graduating, we developed the concept and challenging the very stringent form concept by rotating the houses differently, so they impaired persons different, but related to the same volumes and shapes.

Group b362 Christoffer Thor Paulsen, Kathrine Water, Mathilde Marie Severinsen, Martin Juul Jensen, Malene Højvælde Nielsen, Maria Vittrup Thomsen.

Fig 1
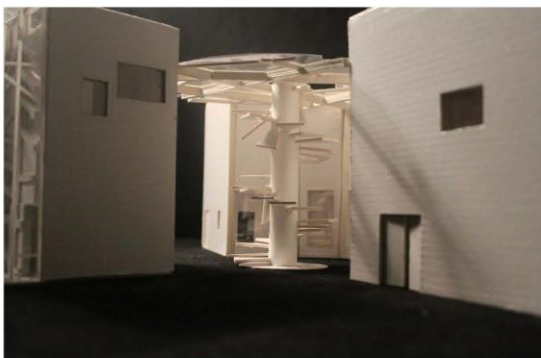
Public accommodations
Before the exam (Fig. 1) was a spiral staircase leading up to the platform, which was available to the public.

After graduating, the site plan restructured, which involved several public spaces in the form of new types of stairs (Fig. 2 and Fig. 3)
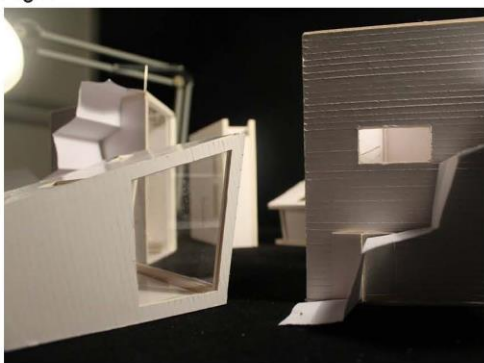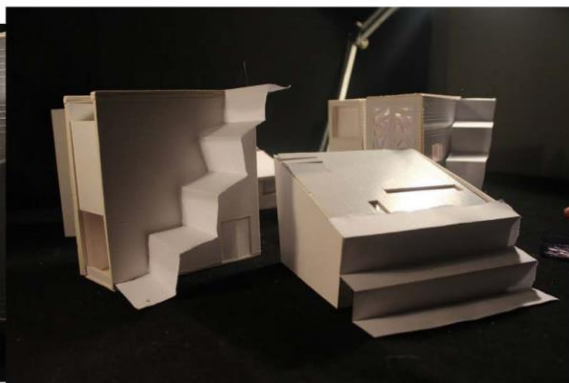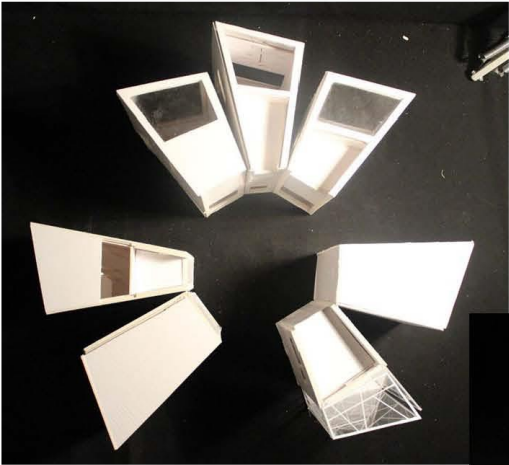
Fig 3

Fig 2

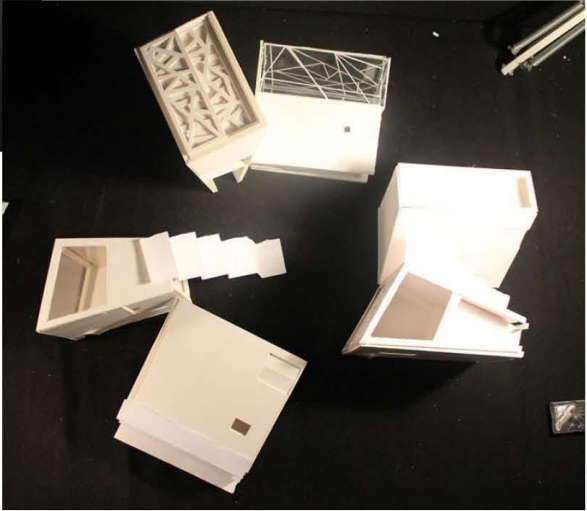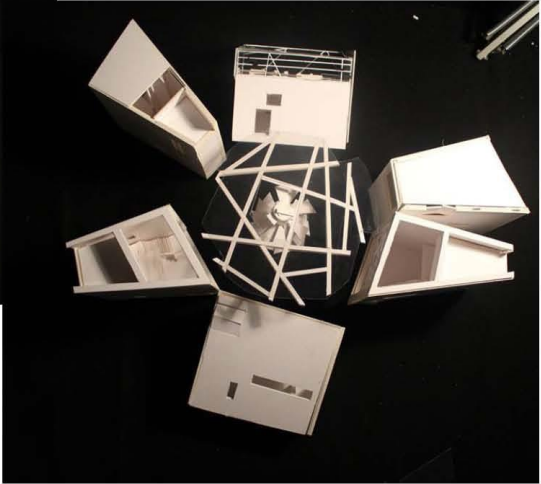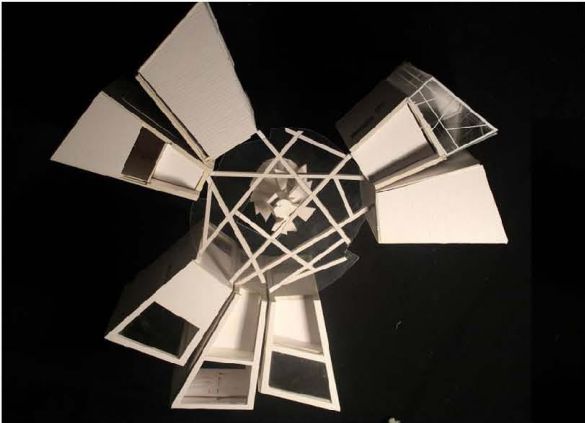Before   After

Site model with only the individual houses

Model wiew with both houses and platform

Thinking in Possibilities: Unleashing Cognitive Creativity Through Assessment in a Problem-Based Learning Environment

Virginie F.C. Servant, Gera Noordzij, Emely J. Spierenburg, Maarten A. Frens *

ABSTRACT

This paper addresses the way in which students' cognitive creativity and the construction of meaning could be fostered by means of assessment in a Problem-based learning programme. We propose that a dual assessment structure within such a programme through examinations and coursework assignments could ensure the acquisition of a foundational knowledge base while allowing the development of the cognitive creative process. Using a Dutch University as a case study, including its assessment philosophy and practice, we describe and tentatively support by means of some preliminary results how assessment can foster construction of meaning. The paper closes on suggestions for practice in fostering cognitive creativity through assessment in Problem-based learning programmes.

Keywords: Problem-based learning, assessment, cognitive creativity

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The need to educate individuals to be "creative" and "innovative" workers has been a pressing issue on the agenda of education policy-makers for some fifteen years, as evidenced by a number of reports and papers on the topic published since the mid-1990s (Bélanger & Federighi, 2000; Centre for Educational Research and Innovation, 2008; National Advisory Committee on Creative and Cultural Education, 1999). In recent years, the idea that creativity should be an integral part of our education systems has been eloquently championed by the likes of Robinson in his TED conference talk of 2006. He refers to a form of creativity that is innate in children, which he calls "divergent thinking", defined as the ability to multiple find novel solutions to given problems. He argues that young children possess this capacity to a greater extent than educated adults, and blames the industrial revolution era standardization of basic education for the decrease in divergent thinking capabilities in young adults. However, in spite of the proliferation of enthusiastic advocacy on the topic, the debate on creativity has been somewhat challenged by scholars' struggle to clearly define the concept.

Despite the vast scope of publications on Problem-based learning (PBL) in all of its aspects (e.g., Albanese & Mitchell, 1993), discussions on PBL and the creative process have been subdued in the literature, particularly from the perspective of cognitive psychology. Equally, little has been said about the role of assessment, particularly in higher education, in fostering creativity. Perhaps this scarcity can be correlated with the challenges in defining the term.

Given the limited literature on the role of assessment in fostering creativity, especially in a PBL environment, building an assessment policy aimed at encouraging creativity requires some creative interpretation of its own, which this paper endeavours to share. The paper, therefore, aims to contribute to the PBL literature by (a) providing arguments for the importance of fostering (cognitive) creativity in higher education as a gateway to the sort of ill-defined professions and the skills needed for the 'knowledge economy', (b) synthesizing theory and exemplifying them through sharing practical experiences on the role of assessment in fostering creativity, and (c) suggesting implications for building an assessment policy in higher education that acknowledges the importance of creativity. Specifically, using Erasmus University College (EUC) in Rotterdam as a case study which combines the pedagogical method of PBL with the content of a Liberal Arts and Science program (Servant, Frens, & Schmidt, 2013), this paper shall describe and analyze the assessment philosophy and practice of EUC in the light of our theoretical discussion to propose implications for further theoretical developments and practice on creativity in assessment.

CREATIVITY, ASSESSMENT AND PROBLEM-BASED LEARNING

Creativity in an Educational Context

Although the word "creativity" has been brandished by education ministers around the world, psychologists still do not understand much about the mechanisms of creativity. It has been determined that the type of mental process that accompanies creative thinking is different to

that which accompanies deductive reasoning (Gray, 2011), but how exactly remains uncertain. In a sense, we are only able to observe the effects of creativity, rather than creativity itself. As Mumford aptly put in 1988: "A review of the extant literature [on creativity] leaves one feeling like Alice, who, upon reading 'Jabberwocky,' commented, 'Somehow it seems to fill my head with ideas – only I don't exactly know what they are' (p.27)". Since Guildford's (1950) pioneering work on creativity, some researchers in psychology and neuroscience have focused their research on uncovering the underlying mechanisms of "creativity", particularly in relation to "insight intelligence" (Jacobs & Dominowski, 1981) and "divergent thinking" (Runco, 1991). Cognitive psychology hypothesizes that the creative process is linked to the activation of a wide range of memories (Gabora, 2002). By a sort of weeding process that discards irrelevant associations and keeps those that serve the purpose of an idea (solving a problem, writing a sonnet, composing a song…); this thought becomes increasingly focused until a new solution is formed. Thus, creativity requires the dual capacity to start with a wide activation function (or area of memory that is activated), and to focus this sufficiently to produce a useable idea in the end.

The role of creativity in learning has been most often connected to problem-solving activities, meaning that creativity is measured by a students' ability to approach problems in a novel way (Fasko, 2001). Runco (2003) defined creativity as follows:

> Creativity can be defined in very literal terms. The basic idea is that any thinking or problem solving that involves the construction of new meaning is creative. (…). Equally significant is the premise that creativity is widely distributed. A wide distribution is implied because virtually every individual has the mental capacity to construct personal interpretations. (pp. 318-19)

We have adopted this definition for the purposes of this paper and refer to it as "cognitive creativity".

Creativity and PBL
The literature has demonstrated a link between PBL and an increase in intrinsic motivation in students (Hmelo-Silver, 2004; Noordzij & Wijnia, 2015; Norman & Schmidt, 1992). Runco and Chand (1995) developed a model of learning, which suggests a positive link between intrinsic motivation for a learning task and creative output in the learning process.

This suggests a potential link between PBL and creative output. And yet, despite this implicit correlation, the link between PBL and creativity has been rather more tacit in the literature. With a few exceptions (e.g., Seng, 2000) the general trend is to refer to problem-solving rather than cognitive creativity in PBL courses, as such creativity is not considered one of the core aims of PBL, and has proven incredibly difficult to measure as an outcome of PBL

programmes. The systematic review of the literature on PBL and creativity offered by Tan, Chye and Teo (2009) serves to further confirm this point – they conclude that:

"Despite the strong interest generated in PBL as a means to cultivate creativity and its sound theoretical rationale, it appears that systematic evidence is scarce and a conclusive answer elusive. There is very little solid empirical evidence supported by a diverse range of high-quality studies that points to the effectiveness of PBL in fostering creativity." (p.30)

One suspects that at the heart of this failure to measure the impact of PBL on creativity lies the above-mentioned challenge of defining creativity. Whilst this paper has chosen to focus on the neuro-scientific and cognitive-psychological definitions of creativity, Tan et al. (2009) chose to include other variants such as the socio-psychological and the psychodynamic models of creativity, which simultaneously broadens the scope of the problem and muddies its waters. These interpretations tie into Freudian and social-constructivist sociological perspectives on the human mind, and while they are certainly interesting, the authors felt that such psychoanalytical and sociological approaches would derail this paper from its primary purpose. In addition, the psychoanalytic and sociological approaches are substantially more difficult to evaluate empirically. Thus, from a cognitive-psychological standpoint, we can state that it is a specific feature of PBL that problems are ill-defined (Moust, Bouhuijs, & Schmidt, 2007), and thus offer a wide range of self-study possibilities. Hence, it is expected that students will come across a much wider range of materials than would be covered in a lecture-based course and thus acquire a much expanded activation function – which we have determined to be essential for creativity from a cognitive perspective.

Assessment and PBL
In contrast to the absence of discussion about the link between PBL and creativity in the literature, much has been written about assessment in PBL, even though the subject has always been something of a bone of contention among scholars and practitioners alike. Indeed, the Founding Fathers of McMaster University's PBL programme believed summative assessment to be detrimental to students' academic progress, relying instead on formative self, peer and tutor evaluation as the *modus operandi* of their self-directed learning programme (Spaulding, 1991). Neufeld and Barrows (1974) clearly attributed the responsibility for academic progress to the students and their tutor, rather than to the so-called unit planners. The criteria against which this progress should be measured remained fairly open. Barrows and Tamblyn (1980) proposed an analysis of all forms of assessment for medical education. In it, they rated multiple-choice questions, short answer questions, essay questions and oral examinations poorly, as they consisted mainly in "pure recall" and did not "correlate well with clinical reasoning skills" (p.116-118). The crux of these PBL pioneers' arguments was that written assessment formatted learning in such a way as to short-circuit students' natural curiosity and destroy their creative endeavor. However, as results of McMasters' students at the Licentiate of the Medical Council of Canada (the final authority of granting a license to

practice medicine) reached record highs (Norman, Neville, Blake, & Mueller, 2010), and as sister PBL school at Maastricht University developed its progress test (Van der Vleuten, Verwijnen, & Wijnen, 1996) the philosophy of assessment in PBL began to change, feeding into a scholarly discussion about the role of assessment in PBL.

There are essentially two questions that need to be answered about the role of assessment in PBL: what to test and how to test it? In answer to the first question, some authors, inspired by the work of Wijnen (1991), are of the school of thought that assessment should be about checking the validity of one's knowledge base as well as one's ability to apply this knowledge in the context of real life (Norman, 1991; Schmidt, Van der Molen, Te Winkel, & Wijnen, 2009). Others, Barrows and Tamblyn (1980) chiefs among them, believe that assessment in PBL should focus on process-oriented tasks (Swanson, Case, & Van der Vleuten, 1991), meaning that assessment should check that students know *how* rather than *what*. For example, in the case of medicine, this amounted to assessing the problem-solving process rather than the content of medicine, under the idea that the two were independent (e.g., Neufeld, Woodward, & McLeod, 1989).

In answer to the second question: *how to test*, the most radical innovation in assessing students in a PBL environment came from Maastricht University. The progress test was brought in to Maastricht's medical school to counter test-oriented learning associated with administering end of course examinations only (Muijtens & Wijnen, 2010). It consists in administering 250 multiple choice questions drawn from a bank which covers the entire medical curriculum, four times a year, throughout a student's undergraduate programme starting in year 1 (Van der Vleuten et al., 1996). Initially, students are expected to score quite low on the test, but as their general knowledge and understanding increases over the years, scores increase proportionally. As such, there is no possibility of "learning for the test" – it serves more as a general indication of progress against which students can measure their chances of obtaining their degree. This innovation was perceived to be so successful that it was expanded to several Dutch medical schools, even to some that do not use PBL, and was introduced at McMaster in 1993 (Norman, Neville, Blake, & Mueller, 2010).

The academic debate in PBL on 'how to test' and 'what to test', provide PBL environments with directions for checking the validity of students' knowledge base as well as students' ability to apply this knowledge in the context of real life, but it does not address the assessment of creativity. Therefore, Erasmus University College has developed an assessment philosophy in which assessment is considered a balance point between academic rigour and increasingly demanding creative endeavour– a philosophy that EUC has coined as *Cogitans in Facultates,* or "Thinking in Possibilities".

THINKING IN POSSIBILITIES – EUC'S ASSESSMENT PHILOSOPHY

Erasmus University College opened its doors in September 2013 in the heart of the Dutch city of Rotterdam. Its programme shares the same basic philosophy as the six other undergraduate bachelor programmes in Liberal Arts and Sciences in the Netherlands (Tak & Oomen, 2012), namely the education of flexible, interdisciplinary workers with the generic skills needed for the 'knowledge economy' (Van der Wende, 2011). Behind this broad description lies a truly challenging interdisciplinary, problem-based three-year programme with a historically strong anchoring in the life sciences, humanities, social and behavioural science and economics, and a genuine connection with the community of Rotterdam (Servant et al., 2013).

With the support of a didactic expert and PBL tutors, the course coordinator composes the problem triggers and provides a list of recommended literature, although students are encouraged to read beyond what is given to them, and tend to do so readily. The learning objectives for each course are deliberately made broad and interdisciplinary to allow students some freedom in defining their learning objectives and handling learning resources. Since the goal of a Liberal Arts and Sciences programme is to get students to engage in the academic debate, assessment methods need to reflect this by offering students the possibility to demonstrate their abilities in applying knowledge and to argue their ideas in a social, scientific and political context.

Students have at least two assessments for each course − firstly, a written examination, which we call the *Foundational Piece* and secondly, a coursework assignment, either written or oral, which we call the *Creative Piece*. A series of smaller assignments, such as essay outlines, on-the-ground research and literature reviews, are given throughout the course and build up to the Creative Piece. These smaller assignments are evaluated by the tutors, under the guidance of the course instructor, and used as constructive feedback by the students. It was decided to leave this role to the tutors as they are in the most convenient position to interact directly with the students throughout the course, and thus to evaluate students' work in the context of the topics covered in the PBL groups. Although we have labelled these forms of assessment *Foundational* and *Creative*, it would be erroneous to deduce that there is no place for creativity in the former and for rigour in the latter. If we could picture a spectrum of assessment philosophy ranging from multiple-choice questions with strictly defined, closed answers on the one end and open-ended questions with no mandatory content at the other end, EUC would place itself in the middle of this spectrum to ensure that students produce creative work while still maintaining high standards of academic rigour.

FOUNDATIONAL PIECE: WRITTEN END OF COURSE ASSESSMENTS AT EUC

Written exams at Erasmus University College represent one side of EUC's *Thinking in Possibilities* philosophy. Written exams aim to ensure that students have acquired the foundational knowledge required for any creative endeavour in the field of study at play. Therefore, the written exams are divided into three parts that reflect a progressive build-up from basic understanding to creative argumentation: foundational knowledge questions, application questions, and constructive argument questions.

Part 1: Foundational Knowledge Questions
Erasmus University College has clearly sided with the view that assessment in a PBL environment should also evaluate knowledge (see Figure 1, question 'a' for an example). Thinking in possibilities means that in order to enable any academic endeavour – creative or other – students must have acquired a base of readily available knowledge. That is, codified concepts that form part of the recognized body of scientific knowledge of one or more disciplines. This foundation acts as the fuel for argumentation, the pigment for the creative canvass of student work. In essence, EUC's approach to education requires students to understand, own, and appropriately and comfortably use the concepts and language of a field of study and the disciplines it contains. This is a *sine qua non* condition of their ability to evolve in that field. These concepts are picked up during the PBL meetings and lectures that accompany the course. We have seen that creativity requires a large activation function, and the breadth and depth of the topics covered in the course and the students' self-study aim to provide just this. Testing a students' grasp of said topics requires the crafting of questions where the understanding of these basic concepts can be demonstrated. Furthermore, knowledge questions serve as a form of priming for the more advanced application and constructive arguments questions. Both questions and answers tend to be standardized, simply because the knowledge assessed here is reproductive rather than creative. However, EUC does not use the progress test (Van der Vleuten et al., 1996) for testing these basic concepts. Firstly, the restrictions of testing a single knowledge-base throughout an entire programme by means of the progress test are ill-suited to a programme which aims to build up knowledge in increasing levels of understanding, and therefore difficulty. Secondly, EUC students are not expected to become experts in a field of study, but like an explorer venturing into a new city, they need to understand its contours, landmarks and most important idioms to get around.

Part 2: Application Questions
Having established a students' ability to navigate around relevant disciplines – or not – the second component of the written examination is constructed around the application of abstract concepts to concrete examples (see Figure 1, question 'c' for an example). This mode of assessment builds onto the foundations evaluated in Part 1. A solid understanding of the foundational knowledge is a necessary condition of a successful undertaking of application

questions. To take up our explorer metaphor once again, now our adventurer has understood the lay of the land and can place the landmarks on a map, it is time to verify that he is actually capable of navigating from A to B, thrown in the hustle and bustle of a real city centre! The written exam will depict situations that closely resemble those seen during PBL meetings, similar enough to trigger the use of appropriate disciplinary tools, yet not identical enough to be a simple case of repetition. In order to score highly, the disciplinary knowledge that the student chooses to apply must flow logically from the case presented in the exam question. It must be convincingly argued and relate to the disciplinary concepts uncovered in the PBL meetings. During PBL meetings, the student-chair, guided by the tutor, will often ask students to conceive of different situations in which the concepts could be applied – thus fostering this sort of thinking process as an on-going part of the curriculum.

Part 3: Constructive Argument Questions

The acquisition of the foundational knowledge of a group of disciplines and the ability to apply this to exemplary, realistic and/or imaginary situations constitute the chief purpose of written examinations at EUC and thus account for the majority of the possible score on these. In addition, there is a third component which, more than any of the others, constitutes the essence of *Cogitans in Facultates*: in the final section of the written exam, students must creatively and logically construct an argument on the basis of a realistic but hypothetical situation (see Figure 1, question 'd' for an example), using the methodological tools of the discipline studied. These situations will usually be of social or political relevance, and require students to imagine themselves in a specific role or to come up with suggestions and arguments relating to the situation depicted in the exam question. To return once more to our explorer, the student now finds himself in unchartered territory, and, using the tools and maps he already possesses, must convincingly map out this new terrain. The metaphor is not that far-fetched, in that these questions are dubbed "exploratory" or "open", and thus genuinely conveys a sense of discovery.

Students first read an article from The Guardian, from the 16 February 2014 about the wake-up call on climate change by Miliband. After that four questions need to be answered:

a. What is hybrid management? (*Foundational Knowledge Question*)

b. What types of hybrid management does Labour leader Miliband refer to in his wake-up call? Give an example of each type, using quotes from the newspaper article. *(Foundational Knowledge and Application Question)*

c. Many governments around the world—especially the USA—have argued that the evidence for climate change and the role of human intervention in this is actually still uncertain. Argue how it can be that such opposing views still exist, paying special attention to the notion of uncertainty and how this affects the relation between science and policy. (*Application Question*)

d. Argue what strategies could be used to come out of the deadlock of scientific controversy and political conflict over the issue of global climate change. Describe two possible strategies. (*Constructive Argument Question*)

e. Use a maximum of 700 words for this questions: 100 for a, and 200 each for b, c and d.

Maximum of 14 points: 2 for a, 4 for b, 4 for c, and 4 for d

Figure 1. Example of an argumentative open-ended question from the first year course 'Science, Technology & Society'

Although students do have some freedom to choose the direction in which they want to explore the topic, to score well, they must do so within the structures of academic argumentation, and appropriately utilizing the tools of the various disciplines they wish to call upon. In this part of the exam, extensive self-study for the PBL problems during the course will prove invaluable to argumentation, providing a plethora of examples and evidence to feed their arguments. Gabora's (2002) exposé on the underlying mechanisms of creativity imply that well-read students should be able to better catch the breadth and depth of a discipline and use their knowledge in new situation.

To sum up, in EUC's PBL programme, written examinations are not monolithic repetition engines as they may be in more classic programmes. Building on the diverse foundations of the disciplines covered by each course, they allow students to demonstrate their understanding of the real-world applicability of abstract concepts – and furthermore, to creatively chisel out their own arguments using the tools of the trade. In the third part of the exam, we aim to give students the opportunity to show us what they are capable of, to challenge them to venture at the edge of their knowledge, to take the next little step into further understanding by experimenting. This is, in the end, what will distinguish between the abilities of students and justify the difference in scoring.

CREATIVE PIECE: OTHER COURSEWORK AT EUC

Coursework, either written or oral, represents the second side of EUC's *Thinking in Possibilities* philosophy. Unlike written exams, coursework pieces are prepared at home throughout the course. These assignments assume that students have acquired the foundational knowledge of the relevant disciplines during the PBL meetings and self-study, and therefore aim for a creative application of the course's methods and concepts to situations of a students' choosing. Here, they can demonstrate that they can play with the materials of the course, following their own interest beyond the point where the discussions in the PBL meetings stop.

FROM PBL PROBLEMS TO CREATIVE ESSAYS

In most cases, students submit a topic of their choice for their paper or presentation, within the range of themes of the course. Since the courses tend to be broad and interdisciplinary, the choice of topics is also extensive. The PBL problems provide leads, which students can follow. When students feel that they resonate with a particular topic and would like to

discover more than PBL self-study will allow, they are encouraged to submit this as an essay or presentation option to their tutor. The debates that go on in the reporting phase provide the student with possible lines of inquiry. In that sense, although the specific assignment topics are self-chosen, they fit with the themes discussed in the PBL meetings.

The composition of an essay or a presentation is done in three stages: 1) Students submit a research question or essay topic; 2) Students submit an outline and a literature review, with one or two difficult arguments developed more fully and 3) Students submit the final paper (between 1500-2500 words, depending on the course) or presentation slides. The tutors guide the students throughout the process. The idea is that giving time and feedback between various instalments of the essay or presentation will provide fertile ground for "insight intelligence" (Jacobs & Dominowski, 1981) to operate. Students are expected to follow the standard rules of academic writing and presentation to structure their work in a coherent and logical fashion, and to provide evidence for all arguments. Once these criteria are met, however, they are free to unleash their creativity on the topic of their choice. All assignments award points for creativity – between 5% and 20% of the entire mark – so as to encourage students to come up with daring arguments and challenging topics. The criteria for what constitutes creativity are decided upon by a combination of the tutors, the course coordinator and EUC's didactic experts prior to the beginning of the course. The tutors then award points according to these criteria when they mark the essays. Points have generally rewarded a student's ability to go further than the material already covered in the PBL meetings, either by proposing a new approach, new insights, new material or connecting the topics of a course in a new way.

CREATIVITY IN ACTION: EUC'S "ORIGINS" COURSE

The following are three examples of student essays, which were handed in for the EUC's first year course entitled "Origins". The objective of the course was to give students a macro-view of history from the beginning of time to the present day, with an understanding of the inter-relatedness of modern occurrences with past, seemingly unrelated events. This approach to the origins of the world has been called "Big History" (Spier, 2010). The instructions were to choose a question of history, and explicitly link it to at least three of six "origins": the origin of the universe, the origin of the stars and the solar system, the origin of the Earth, the origin of Life, the origin of Humans and the origin of Civilization. The aim was to get students to think broadly about historical questions by placing them in the context of at least three different time scales.

Origins of the mayan civilization
One student chose to ask the question: "What are the origins of the Mayan Civilization and what were their concepts of time and space in relation to the origins of the Universe?" The

essay looks at the origins of the Mayan civilization from three perspectives: anthropological, following the migration of early humans to the American continent; historical, looking at the development of the Mayan civilization over time; and literary, describing the myths that the Mayans used to relate to the origin of the universe. As an example of "divergent thinking" (Runco, 1991), this student has decided to leave the "origin of the universe" until last, even though this was the first item covered in the PBL problems and is chronologically antecedent. The idea for this essay came to him during the course of the first problem, in which the PBL group discussed alternative views to the origins of the universe. He was particularly interested in the Aztec and Mayan legends, but there was no scope for expanding on this subject during the PBL meetings. Thus, he developed his interest and creativity in the end-of-course paper .

Origins of DNA

Another student chose to address the question: "is DNA a unique pre-condition for life?" – In her essay, she chose to contrast the biological importance of DNA in the origins and evolution of life and humans with civilization's long road to understanding heredity, from the ancient Greeks to the discovery of the sequencing of the human genome. The essay offered a strong grounding in biology, placed in the context of a historical study. The ideas for this essay developed after the problem on the origins of life. The "aha" moment came when the student discussed the topic in the PBL group and the tutor asked if she had considered the possibility of creating life out of silicone instead of carbon. Since the paper proposed some quite advanced ideas, subject-matter experts were called in to assist the tutor in evaluating the merit of some of the biological arguments. This reflects a general understanding at EUC that we do not restrict students' creativity by our own limitations. If a tutor is not able to adequately assess a students' work because it goes into areas with which he or she is not familiar, there is always somebody within EUC's network who can assist.

Origins of scientific theories

One student chose to ask: "Is the process of entropy also occurring in the forming of new scientific theories?" This was one of the more challenging pieces in its ambition to transpose a difficult concept of theoretical physics into a philosophical context. Indeed, this essay looked at the evolution of theories of the origins of the universe from ancient astronomy to super-string theory, mapping their trajectory. It concluded that indeed, scientific theories are becoming more, not less disordered with time, despite attempts at unification, and therefore one could speak of "entropy" in the process of scientific enquiry. This student was particularly interested in the philosophy of science, and for almost every origin problem, brought to PBL meetings classic scientific and philosophical accounts, from Buffon, to Kant, to Laplace. Her argument was daring, and as such, the essay went through many drafts before reaching its final stage, but it exemplifies the creative possibilities allowed by this form of assignment, especially for freshmen students.

The common feature between these three assignments is that they all have grounding in the PBL problems that were offered during the course. These papers came from students' desires to go further into some aspects of the problems that they found particularly interesting. We have seen in our literature review that by their very nature, problems open-ended up a wide range of self-study possibilities – and this seems to be reflected in the breadth of the disciplines covered by the three papers. We have yet to test this empirically – and the review by Tan et al. (2009) has shown that this may be no mean feat – but our experience indicates that students feel a sense of ownership and pride when they discover aspects of a problem in a PBL meeting that other students did not encounter – these tend to be the topics that they choose for their essays.

Below are some preliminary indications of how our students fared in producing creative work, both through coursework, such as essays and presentations, and the constructive argument questions of the written examinations.

PRELIMINARY INDICATIONS

Although EUC is still a very young institution and this paper is conceptual in nature, rather than empirical, after EUC's first two academic years there are some preliminary indications of the beneficial effects of its assessment policy. Given its creativity-oriented assessment philosophy, EUC has translated this to regulations that state that in general a written exam (the *Foundational Piece*) should consists of 40% foundational knowledge questions, 40% application questions, and 20% constructive argument questions. For the coursework assignments (the *Creative Piece*), a variable part of the grading should be for creativity and/or constructive arguments, depending on the assignment.

As an overview, in EUC's eight first-year courses over two academic years, the exams assessed foundational knowledge, application of knowledge and constructive argumentation by means of open-ended questions or a combination of both open-ended and multiple choice questions. Exam questions were not always developed according to the 40% foundational knowledge – 40% applied knowledge - 20% constructive argumentation guideline, mainly due to the challenges of getting everybody on the same page in a start-up institution, but this tended to normalise as time went on. The content of a course was an important factor in allocating questions to the three categories and the choice of questions within each category. Indeed, it stands to reason that on the one hand, in a statistics exam which is almost exclusively based on foundational knowledge, this would be assessed by means of multiple-choice questions only, and on the other hand, the examination of a humanities course would stress applied knowledge and constructive argument questions evaluated by means of open-ended questions.

Although we have not conducted any formal qualitative studies on the subject, informal feedback sessions with first-year students about their experience with the exams have indicated that the fundamental knowledge questions are easier to them than the applied knowledge and constructive argument questions and this is also represented in their scores on the different questions. For example, in a Social and Behavioural Sciences course, students scored significantly higher on foundational knowledge questions (M = 77.4, SD = 15.4) compared with applied knowledge and constructive argument question (M = 57.3, SD = 13.8), t (100) = 13.6, $p < .01$. However, although more difficult and challenging, most students stated that they really enjoy the questions that enable them to demonstrate their understanding of the real world and crave building up their own arguments based on the knowledge and the skills derived during the different courses. This is indeed something that the tutors, course coordinators, and didactic experts at EUC have observed by looking at student results so far (although as stated, this is presently a mere observation that warrants further empirical research).

For the coursework assignments, in six out of the eight first-year courses students were required to hand in a paper or essay and in two course students were asked to give a presentation. For these coursework assignments, students' constructive argumentation and creativity could make up between eight and twenty per cent of their final grade. In line with the preliminary findings of the written exams, in general, students scored lower on this part of their coursework assignments compared to the other parts, such as structure, content, and presentation skills. For example, for the essay of the "Origins" course the score, in percentages, of students' creativity and constructive argumentation (M = 69.7, SD = 16.8) was significantly lower compared to their scores on the other parts of the essays or presentations, such as structure, content, writing skills or presentation skills (M =78.8, SD = 15.0), t (101) = 3.34, $p < .01$.

Having noticed the differences between the scores of the first-year students on foundational knowledge and skills and content on the one hand, and application and constructive argumentation on the other hand, it might be assumed that these differences should diminish when students develop their cognitive creativity in their second and third year at EUC. Further research should, therefore, address the improvement of cognitive creativity in PBL longitudinally by means of an empirical review of the results. In addition, by systematically interviewing students we would gain more insight into students' experience and evaluation of the dual assessment structure with its different levels of assessment.

IMPLICATIONS AND CONCLUSION

Firstly, one of the most challenging implications of the assessment of cognitive creativity in PBL is the alignment of course content and assessment. This means that topics addressed in

the assessment should allow students to apply the abstract concepts of the course topic to concrete examples and to logically construct arguments derived from the course topic to explain realistic situations. In addition, exam questions should depict situations similar to those experienced during the PBL meetings and in the problem triggers in order to help students to activate the relevant parts of their long-term memory. This has particularly important implications for course coordinators and developers, who should therefore develop the problem triggers of a course concomitantly with the course assessments and think of the two in an interrelated fashion rather than sequentially, or even separately. This does not mean that once designed, exam questions should be immovable: PBL always allows for the adjustment of exam questions based on students' reactions to PBL meetings, and their self-study. It does mean, however, that assessment must be considered as a pedagogical tool rather than a mere testing tool, and this idea must be thoroughly embedded in the structure of a PBL programme, including allocating the appropriate amounts of time for examination and coursework development.

Secondly, as we have seen, assessing cognitive creativity allows students to demonstrate what they have learned during their self-study and to take this one step further by making them apply it in new ways during the assessment, fostering their creative development. Another implication is, therefore, that it is important to adjust the assessment of creativity to the level of the student and to build it up in line with the development of students in their successive years.

However, even though this paper concerned itself with the case study of a university programme with entry-selection, constructive argumentation is by no means an elite skill that can only be acquired by students in the context of university education. Instead, it could be argued that all young adults, regardless of their educational background, need to develop this capability given the constantly changing professional and social environment we live in. This implies, therefore, that cognitive creativity should be an integral part of our educational system at all levels. As we have mentioned, developing constructive argumentation should be tailored to students' experience level within an educational programme (whether they be first or final year students), but also to the level of education more broadly across programmes, whether applied or theoretical, university or professional. This also implies that further research on this topic should go beyond university programmes and look at, for instance, polytechnic and applied sciences programmes as well as professional training courses that use PBL.

In conclusion, the authors feel that assessment is an important and often under-rated tool for promoting creativity, viewed from a cognitive-psychological standpoint, in a PBL programme. To do this, assessment must not be conceived as a monolithic knowledge-repetition machine, but as a rich pedagogical tool with three facets – foundational, applied and constructive – that need to be used appropriately to generate creative growth. We are hopeful

that the ideas proposed in this paper can provide some guidelines towards developing assessment policies in present and future PBL programmes, however, given the conceptual nature of our present argument, this leaves the door wide open for empirical studies to support the ideas put forward herewith.

Acknowledgements

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Play as mediator for knowledge-creation in Problem Based Learning

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ABSTRACT

This article recounts reflections by a small group of students and their supervisor on play utilized at their meetings as part of a Problem Based Learning (PBL) process. The students experienced how a less traditional professor-student relationship arose, which transformed their interaction and relationship into a more holistic, trustful, sensitive, open, creative and collaborative form that gave rise to the following questions: what can a more playful approach bring into a PBL learning-space? What influence can play have on learning, and on student-to-student and student-supervisor relationships and collaboration? Why did the students find that this experience enhanced a learning that differed from their earlier experiences? What was it play had mediated? The article, which is also a theoretical discussion of future pedagogics in Higher Education, introduces a new model including three different knowledge forms. These take their departure from a PBL approach - regarded as a 'problem-solving' approach to learning, and PpBL (Play and Problem Based Learning), a 'playful', experimenting and intuitive approach.

INTRODUCTION

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At Aalborg University, where the study for this article has been conducted, the overall pedagogy is PBL. This is a pedagogy based on learning organized around concrete practical or theoretical challenges in which students are expected to gain new and flexible knowledge through context-related learning processes (Bateson, 2005), self-directed learning processes (Laursen, 2004), and problem-solving processes (Hmelo-Silver, 2004). Through group-work and practical challenges, the students learn how to solve a given problem, seek new knowledge and gain new knowledge by the use of meta-cognition as a reflection on performed learning processes. They also learn to bring in cross-disciplinary theory and methods in their approach to their projects (Kiib, 2004).

In spring 2013, a small group of students from Communication and Digital Medias at Aalborg University were given the task, as part of their Bachelor's project, to construct, conceptualize and facilitate a creative workshop for a consultancy firm. The overall idea was to use play to bring groups of Danish primary school teachers to a closer understanding of their own role in a team and through this enhance their individual and mutual abilities as collaborators, as a way of fostering a better team-spirit and stronger teams in general in the work-place. As play was regarded as an ideal mediator for change, creativity and learning by the consultancy firm, this became the pivotal point of the creative workshop that the students were to develop.

During the PBL project the students and their supervisor sensed that something unexpectedly interesting was happening. It seemed as if play itself not only had an impact on the teachers participating in the workshop facilitated by the students, but also, amongst the students themselves and in their relationship to the supervisor, something different than 'normal' emerged. The PBL process in general became more experimental and intuitively driven compared to previously. The students became more courageous and creative. Hence, two of the students and the supervisor decided to examine more thoroughly their experiences from the PBL process retrospectively.

It is these dialogues and shared reflections that are the springboard for the article, which begins with an introduction to PBL and PpBL, together with a brief elaboration of the under-laying understanding of play with reference to creativity. Secondly, a new model is introduced and discussed to elaborate the different knowledge-forms related to PBL and PpBL. Thirdly, the students' experiences are verbalized by the students themselves and finally the article offers some answers to the opening questions.

PROBLEM AND PLAY BASED LEARNING

In 2004, PpBL as a new approach to PBL was introduced at Aalborg University by the faculty of Architecture & Design (Kiib, 2004). The overall idea of PpBL was a stronger focus on

experimentation and the creation of an inter-play between students' ability to be intuitive, aesthetic creators and at the same time goal-oriented. Earlier on, focus had primarily been on the problem-solving part of the projects, but now Danish professor Hans Kiib argued for a deeper emphasis on intuition, innovation and phenomenology. Kiib also asserted that this approach should not solely concern educations traditionally considered as creative, like Architecture & Design, but in general include all degree courses. As Kiib wrote with reference to Schön (Schön, 1987) and Kolb (Kolb, 1984) *"PBL requires intuition, play and action in a continual dialogue with reflection and rational problem solving… as a working principle in both practice and learning"* (Kiib, 2004, p. 204).

To our knowledge, Kiib did not elaborate more thoroughly what he meant by play and intuition at that time, nor did he return to this subject later, but he did suggest something interesting to follow up on. Mindful of German-American researcher Claus Otto Scharmer and his wife Kathrin Käufer and their ideas of a future university pedagogy (Käufer & Scharmer, 2007), a close dialogue with German philosopher Hans-Georg Gadamer and his understanding of play, together with our own experiences, we will now scrutinize more thoroughly the consequence of bringing play into PBL or PpBL, as Kiib calls it.

FROM CREATIVITY TO PLAY

For the students, in our case, the main task of their practical part of the PBL process was to design a creative workshop. Creativity is regarded as *"our ability to play with ideas, thoughts, possibilities and materials"*, as Danish researcher in innovation, Lotte Darsø, defines it (Darsø, 2011, p. 26). For her play is the source of all creativity. Mainemelis and Ronson also call it the 'cradle for creativity' (Mainemelis & Ronson, 2006). Hence, for the students it was natural to bring play activities in as a way to enhance creativity amongst the teachers participating in the workshop.

PLAY AS A UNIVERSAL LIFE-PHENOMENON

Let us begin by defining an overall understanding of play. One of the best-known theorists in the field of play was Dutch historian Huizinga (1872-1945), who regarded play as a universal life-phenomenon that goes with being a human being (Huizinga, 1963/1993). No matter who we are, where we come from, how old we are, what we do, or what we believe in, play has a natural role in all our lives. This means that play counts for all ages, genders and cultures and therefore also has relevance at a university, amongst students, if we follow Huizinga. From a more philosophical point of view, play can also be explained as a fundamental expression of life - or a sovereign expression of life, if we use the term of Danish philosopher Løgstrup, meaning a moment of a certain ontological value that has precedence over everything else

(Løgstrup, 1995 (1976). It is a moment where we are captured by life itself and therefore in play there is something "at play" which transcends the immediate needs of life (Huizinga, 1963/1993). 'Play as a sovereign expression of life' is Thorsted's interpretation and not that of Løgstrup. Like other theorists (Apter, 1991; Gadamer, 1960/2007; Huizinga, 1963/1993; Øksnes, 2013, Thorsted does not regard play as a solely physical activity, or a tool for solving specific purposes, but as a life-phenomenon with its own value. Play therefore has an inexplicable impact on all our lives.

More generally speaking, most people's motivation for play is the sheer pleasure of doing it, to have fun, but this does not mean that play is not serious. We see it when animals play together, or we feel it as human beings when we are 'captured by play' itself and forget everything else around us (Gadamer, 1960/2007). As parents, we know how a child can be fully engrossed by a computer game or a role-play for instance. When playing, we are carried away into another time, a parallel world to the real world, offering us the possibility to try out 'as if' before actually putting an action or an idea into practice (Apter, 1991; Gadamer, 1960/2007). We are in a moment of deep presence; a unique space where time stands still and we lose ourselves in pure 'being'. While playing, nothing else matters but what is at stake in the playful act. We feel free, alive, and deeply engaged.

Often play is brought in with the ambition of reaching a specific goal, following the idea of a certain outcome in form of learning or development facilitated or guided by professionals. This can be orchestrated by teachers, pedagogues or organizational facilitators, as in our case, where the students utilized play to approach a given task, to support the group of teachers in their shared understanding of the team and their own role in the group. In the dominant discourse on play in research literature, play is approached as asserted above from a biological, sociological, anthropological or psychological perspective, founded on the belief that play is a tool we can control, a certain *play-experience-learning* that we can prepare and predict (Øksnes, 2012).

But several philosophers are putting forward another perspective. They are advocating for an acknowledgement of play as an uncontrollable life-phenomenon, an ontological event, a '*geschehen*' or a comprising moment in which we are grasped by life itself and admitted into the unknown, to return to something more than we were before we started playing (Gadamer, 1960/2007). This is why we also speak of play's existential and ontological impact on our lives and the issue of *play-experience-Bildung*, transcending moments in which something unpredictable happens, when we do not approach it as a *"useful and/or speculative instrument in the service of fulfilling certain functions…"* (Øksnes, 2013, p. 142). This distinction between play as 'play-experience-learning' – something we use for a certain purpose – and play as 'play-experience-*Bildung*' regarded as a relation of a certain quality we enter between us and the world – is important for the continuation of the article.

PLAY AS ENTRANCE TO KNOWLEDGE CREATION

So far, PBL has primarily focused on problem solving through context-related learning, as Kiib called it, which led on to the creation of *explicit knowledge* and *tacit knowledge* (Schön, 2001). Students gain 'explicit knowledge' from reading books and articles and participating in lectures based on past experiences and thoughts already articulated. 'Tacit knowledge' is acquired through reflection *in* or *on* action. 'On' action' means students reflecting on their own gestalted experiences or thoughts based on practical experiences. Reflection 'in' action is when they reflect on a concrete learning situation or a cognitive learning process emerging through action. Both approaches are based on an overall wish to find a solution to a given task.

When Kiib argues for PpBL he talks of a learning process, based on a practice-oriented departure framed by a concrete goal, and, at the same time, of play as a way to foster more aesthetic and creative students through more experimental learning processes. Other advocators for more imaginative and creative students are Scharmer and Kaüfer, but their attention is not on the past, the *ontic*, and the already-established impression. On the contrary, their focus is on the *ontological* aspect of an experience[1], the moment where we are present and open to the unknown and future possibilities that can lead us to what Scharmer calls *not-yet-embodied knowledge* or *self-transcending knowledge* (Scharmer, 2007). Like Øksnes, speaking of play as a way to become self-forgetful and open to the unknown, Scharmer argues for a need for a 'certain engagement' in the world.

But are not Schön and Scharmer talking about the same thing, when they both look at the practitioner reflecting *in* action? The short answer is no. The practitioner in Schön's understanding reflects *on* the reality and proactively engages himself to the world, motivated by a wish to 'solve problems', 'gain new competences' to approach future challenges and hereby 'approve practice'. Scharmer on the contrary is engaged in creating a deeper sensitivity for *what-is to-come* before acting. *"Celebration of what is dialogic, unfinished, open, transcending time and the future"* as Øksnes expresses it, with reference to play and

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[1] The difference between 'the ontic' and 'the ontological' is fundamental one, which Martin Heidegger (1996/1927) discussed in detail in *Being and Time* as a difference between being in a *functional* mode or in an *existential* mode in a concrete moment. He considered how this difference opens up the world diversely (the way the world unfolds in our engagement with it) and the way we see and understand it. When we are in 'ontic' relation with the world, we are in a proactive 'doing-mode', but when we are in 'ontological relation' with the world, we are in a self-forgetting 'being-mode'. Problem-solving and critical-analytical reflection are typically connected to 'the ontic', whereas being in a state of wonder, playfulness, artistic process or contemplation is connected to 'the ontological'.

carnival (Øksnes, 2013). To create deeper contact with students' creative capacities and their own calling and to allow time for new ideas and knowledge to mature. Metaphorically speaking, one could say that Scharmer's focus is on fertilizing the soil before harvesting[2]. Scharmer's interest lies in the ontological and existential aspect of life that relates to play-experience-*Bildung*, as opposed to Kiib, whose attention primarily is on the ontic and play-experience-learning, whereby play is a function. Given Kiib's reference to Schön, we interpret his motivation for bringing in play regarded as a tool for creativity and not an acknowledgement of the true value of play itself, which we believe can never lie in the direct outcome of play. *"In play, we face and accept the risk of the human situations directly, and in doing so we realize the satisfactions and joys of our essential selves"*(Hackett, 2013, p. 128). Hence, the result of play in Kiib's approach to PpBL most likely leads to play-experience-learning and not to play-experience-*Bildung* or to the emergence of a not-yet-embodied or self-transcending knowledge, which arises from an ability and courage to take risks, stand in the open and to *wonder* about more fundamental philosophical questions (Hansen, 2008).

KNOWLEDGE MODEL FOR PPBL

Before turning to the students' experiences, we introduce a model as a point of departure for further discussion. Were the students' reflections primarily on the past or the present, the ontic, as Schön and Kiib are talking of and 'just' a matter of approving their own skills through play-experience-learning? Or did they also through the play-based approach give space to play-experience-Bildung? To answer these questions Ann Charlotte Thorsted has developed the model beneath to outline the differences between PBL and PpBL and their different knowledge forms (fig. 2).

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[2] Thorsted has developed a model called FIE, based on some of Scharmer's ideas, to help students and organizations navigate in creative or innovative processes (Thorsted, 2014).
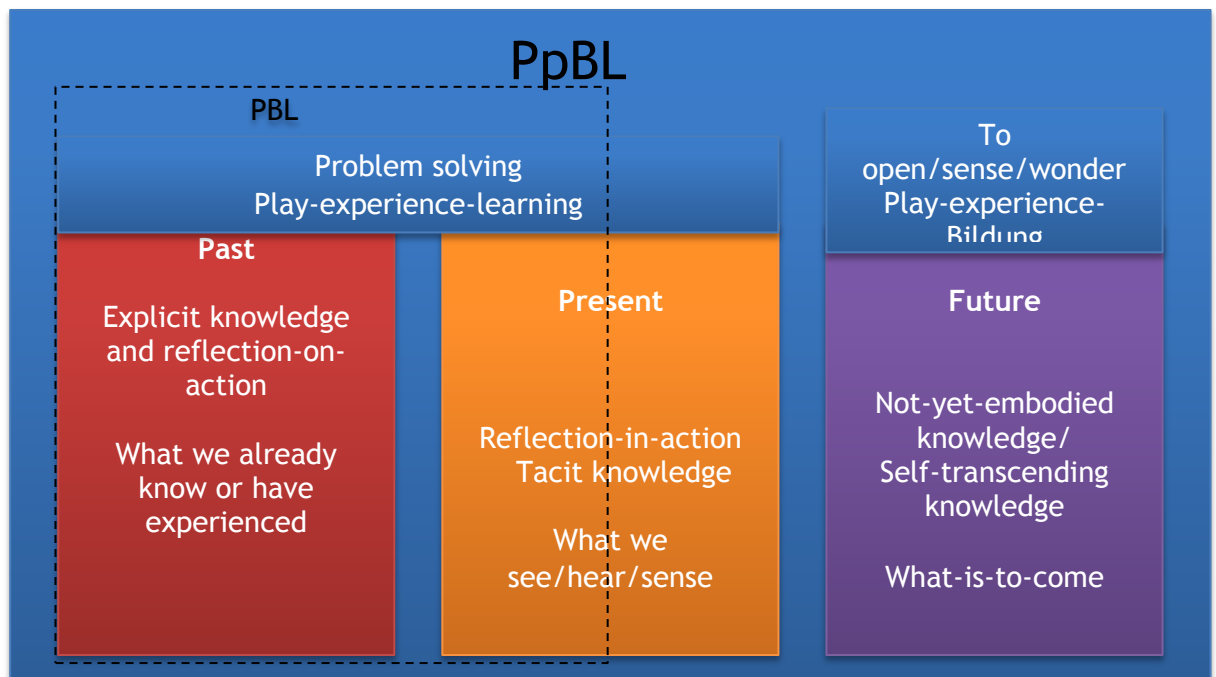
Figure 2: Knowledge-model for PBL and PpBL

In traditional PBL, focus is on problem solving, bringing in knowledge based on the past or the present. In regard of the past, students reflect on what they already know or have experienced (reflection-on-action), which is the first box of the model. The second box (present) symbolizes what happens when students reflect-in-action, which is a matter of reflection on present realities. This is still guided by a wish to find a *solution*, but in this case we talk of a more intuitive and reflective cognition, where practice and theory are expected to melt together in the urge for a specific learning outcome. In the first two boxes, play is regarded as a tool, as we believe Kiib saw it - something we ourselves can govern and subordinate to our needs and a way to accomplish a certain play-experience-learning outcome. In the last box (future) we have moved away from a functional and problem-solving modus. Instead, we are now seeking another kind of awareness and approach to learning that requires a more profound engagement and the will to let go of control, as Scharmer expresses. This is essential to our understanding of PpBL, a type of learning where participants have the courage to risk their selves to 'give birth to something new' as American existential psychologist Rollo May (1909-1994) describes it (May, 1975/1994), which is fundamentally different from the first two approaches to learning (past and present). Therefore, we bring in Scharmer's third kind of knowledge in our discussion of PpBL. A not-yet-embodied-knowledge that emerges from more *generative* dialogues (Scharmer, 2007) or the *wondrous* dialogues of Danish professor F. T. Hansen (Hansen, 2008; Hansen, 2014). To be creative or innovative we must open ourselves to make what-we-do-not-know welcome, to give room to

the unexpected as Darsø formulates it (Darsø, 2011). When play as an ontological event catches us, we start listening and sensing more intuitively, but this requires that we let go all our expectations and allow whatever calls us in that precise moment to guide us. In this way, knowledge creation becomes more than a directed process explicated through specific learning goals formulated at the beginning of the learning process.

THE CASE STUDY

To recapitulate, the aim for the students' project was to design a creative workshop for a small team of teachers from a Danish primary school, containing playful elements in order to give the participants an enriched and shared understanding of the team. The students designed the workshop in cooperation with a small consultancy firm, whose founder and head consultant sought new creative inputs related to the team understanding process. The workshop held three main activities and an icebreaker, all enrolling play as a mediator for the creation of shared understanding of their interpersonal relationships and thereby their respective roles, their communication and relationship to each other.

For the article, the entire project has been divided into three parts. The first part describes the students' preparations for the workshop, the second part, how the workshop was facilitated and lastly, some afterthoughts. The workshop was sound-recorded and transcribed and, together with written journals of the students' reflections during the project, this constitutes the empirical data for the Bachelor project and this article. The students' own formulations of their experiences and their points of view are presented almost as they were expressed in the first draft for the article.

PREPARATIONS FOR THE WORKSHOP

The students write: Inspired by our supervisor and associated professor Ann Charlotte Thorsted's work with play and creativity, we applied for Thorsted as a supervisor for our Bachelor project. Without any participation from Thorsted, we had already established contact with the consultancy firm before our first meeting. Our general expectations for the project were not in any way unusual or out of the ordinary; we expected an academic, educational and challenging PBL process with a relatively professional relationship to our supervisor – as in previous semesters. Thus, it was without any extraordinary expectations we arrived for the first supervision meeting. Great was our surprise when Thorsted brought out for us six dice with different figures on each side, the so-called Story Cubes (figure 1). She suggested that we took turns to throw two dice and used the outcome from the throw to introduce ourselves and formulate what we were engaged in at this precise moment of our study. The dice showing an 'eye' could, for instance, be an opportunity to express how one of us regarded a concrete situation.

Figure 1: Story Cubes

Despite being a simple act of a telling a personal story, retrospectively this seemed to be the beginning of a different and more holistic way of collaborating, in which we as a group and in relation to our supervisor, took a step towards a higher degree of openness, sensitivity, trust and thus a space for everyone to be themselves. We will not elaborate further on the Story Cubes, as our interest do not lie in the actual play activity or tool itself, but in the role of play more generally speaking in relation to our project.

The fact that we played together and that Thorsted showed interest in us as persons and not only as students, made our relation to her more equal and relaxed, which for instance led to a significant use of humor at our meetings. We had seldom experienced such an honest and liberating meeting in a professional educational context before. We spoke about what was on our minds in an unrestricted social frame compared to previous experiences. One could argue that this seemingly insignificant event with the story cubes might hold an impact for the months to come, but we strongly feel today that this first impression and experience of play became a key milestone that struck a note for how the entire project was carried out – both in regards of the relationship between us as students and between us and our supervisor.

Halfway through the project, we needed to take the necessary step away from reading, theorizing and conducting academic discussions to be able to create an actual real life workshop. This was a crossroad in the process, where we had to convert "perfect" theories and delimited ideas and conceptions into a concrete workshop, useful for the consultancy firm and the participants in the workshop. But we felt stuck and frustrated. The process went very slowly. However, an important turning point occurred, when one of us took the initiative to set up and facilitate a creative session amongst ourselves, in which each of us had to take on the role of a famous person. This could, for instance, be Albert Einstein. The challenge was now to think as the given *persona*. What would be the most interesting aspect of understanding a team of teachers if one were Einstein? Despite ending up with somewhat

predictable topics such as 'roles, communication and relations' that could lead the teachers to a deeper understanding of their team, this session mediated topics in a way that we believe a rational discussion could not have provided. By adapting a playful approach, we felt more liberated and able to try out and not hold back even some more crazy ideas.

Before the real workshop with the teachers was carried out, we tested two of the main activities in it with help from two other groups from the university, to see how the play activities worked and how much time it would require. This was the first time we tried our roles as play facilitators. In addition to this learning, we had studied Thorsted's (Thorsted, 2013) and Bente Halkier's (Halkier, 2008) thoughts on facilitation and reached the conclusion that facilitating a playful process requires knowledge, but also an ability to let our intuition guide us. By trying out two of the exercises of the workshop beforehand, we gained a vague feeling of what might happen at the workshop, but this counted primarily for the more practical aspects of the session. The 'uncertainty' and 'unpredictability' as part of the facilitator role (Thorsted, 2013) was something we could not fully prepare for.

FACILITATION OF THE WORKSHOP

We began the workshop by introducing ourselves and the aim of the project. Beforehand we had agreed on our different roles, one as the main facilitator, one, the helping facilitator and the last, an observer (Halkier, 2008). After the introduction, we started out with an icebreaker exercise utilizing the Story Cubes for everyone to present themselves to the others. All of us took part in this first exercise. Afterwards, the participants described the icebreaker exercise as 'personal', 'fun' and 'creative'. The ambition had been to use the exercise to build up a relationship within the group and to create a more trust-based space that could support the playful attitude and help the participants overcome conventional thinking (Thorsted, 2013), just as we had ourselves experienced. We will not go deeper into elaboration of the other play activities performed but turn towards our reflections after having finished the project.

AFTERTHOUGHTS

Retrospectively, it has become clear to us how important our way of facilitating actually was for the whole process, and how difficult it is to navigate in moments of uncertainty. Both our lack of facilitation at times and, at other times, over-controlling facilitation had an important impact on the participants' response and ability to be playful. It was really hard to navigate in a process where one could not predict beforehand a specific outcome. Therefore this experience and the project as a whole turned out to be quite different from the other processes

we had participated in. This time we had to rely on our instinct and ability to be open and let go our desire to be in control.

A CHANGE IN THE INTERPERSONAL RELATIONSHIP

We have now heard the students describe their experiences, which led to the following questions: What had the playful approach brought into the relationship and the collaboration between the students and their supervisor and what had the more playful approach to PBL offered in relation to their learning?

The students described a change in the relationship between themselves and their supervisor starting from the very first meeting, where the supervisor took the initiative to use Story Cubes to introduce them to each other. This fueled a more open and personal engagement and a feeling of trust, which had an impact on the entire project. With reference to Thorsted's research, the change in relationship can be explained through the development of a *community of play; "where play as a sovereign expression of life has taken over, filled the players with its own spirit and pulled them into its own sphere ruled by the beat of life itself. In a community of play, the players have surrendered to play as a life phenomenon and become self-forgetful, placing some of their life into the hands of their good colleagues. In a community of play you feel safe and free, everyone is equal, there is no power negotiation, just a will to collaborate and, at the same time, allow space for the individual to experiment and just be"* (Thorsted, 2014, p. 16)*".* In the group the students and the supervisor acted no longer only as professionals. They also allowed a more personal side to come forward, which can feel vulnerable. In this case, it led to more open and honest dialogs and the development of a more trustful interpersonal relationship and a starting acceptance of the risk related to play, which fostered the courage to experiment.

COURAGE TO BE CREATIVE

According to the students, another turning point was the emergence of three topics from their small exercise utilizing famous persons to outline the main topics for the workshop. They had reached a crossroads and, leaving behind them safe ground, perfect theories and delimited ideas, were now confronted with a concrete creative demand in regard of the workshop. With reference to the famous sculpture of David by Michelangelo, they articulated the experience in this way; when Michelangelo is asked for an explanation of his aesthetic process, he explains it by saying that 'David was already in the stone. He just took away everything that wasn't David' (Scharmer, 2001). As an analogy to their own process, they found themselves emptied for new ideas. Not until they began playing, working more intuitively, enacting different roles, did they grasp some of the notions of what could be considered important

aspects for the further process (they found David in the stone). Through the playful and creative process, they overcame their obstacles and found an answer to their challenge – they took away everything that wasn't David.

Intuition requires that we dare to put ourselves at stake, let ourselves be absorbed by the moment and through this get access to the world of our existence, not only as a matter of reaching certain facts or conceptual understandings, but also to let life itself impress us. For the students this was a new way to approach learning that gave them courage to experiment, enter the unknown and let go of control. They began to sense and listen more freely, not allowing their assumptions and already-established knowledge overrule their instincts. This came forward, especially in the design of the workshop, which was very original in its form. They developed their own play exercises, which the consultancy firm was quite impressed by. The workshop facilitated by them was a challenge, as their experience in facilitation was limited, but the project as a whole became quite original and interesting.

FROM PBL TO PPBL

Let us now return to figure 2 once again to see what kind of knowledge the students gained. In the beginning of the project, they drew on literature and lectures based on the past (explicit knowledge) and their own reflections *on* earlier actions performed in other PBL projects (tacit knowledge). As we have already heard, when Schön talks of 'reflection-in-action', his focus is on learning to improve or solve. But this solving attitude conflicted with the creative skills that the students needed at the crossroads, where they had to develop new ideas for the workshop. At this point, they could not rely entirely on what they already knew; instead they had to 'reflect-in-action' or let "what-is-to-come" emerge. The students described it themselves with reference to Michelangelo: "take away everything that wasn't David'". This could lead us to interpreting the learning situation as - they tried to let new ideas emerge by letting go a desire to perform something specific and instead led play and through this, their own senses guided them to 'what-was-to-come ('future' in figure 2). On the other hand, they also described the situation as a need for conceptualizing a workshop for the consultancy firm. In this case they might still have been in a functional and goal- directed mode, which is the middle box in figure 2, where they do something different than normal, but they are not really playing. This Thorsted calls a 'creative-everyday-break' *"characterized by moments when we do something differently from normal, which might feel creative"* (Thorsted, 2014, p. 9). When taking a creative-everyday-break, players have not surrendered themselves to play and therefore still remain in the ontic mode.

The distinction between reflection-in-action and the creation of play-experience-learning or play-experience-Bildung can be difficult to establish. As Øksnes writes with reference to Gadamer: *"the player does not know what exactly he "knows" in knowing that"* (Øksnes,

2013, p. 147). What is important for us to emphasize is that the approach and possible outcome of the two differ from each other. To reach a not-yet-embodied-knowledge and a play-experience-Bildung (future) the students would also have to open themselves to a more ontological and existential influence, which could lead, not only to a creative idea to build on in the workshop, but also to an impression that could hold an existential impact (Hansen, 2014). In this case we would talk of a Bildung emerging from a playful moment of a certain contemplative character that makes space for new possibilities and for Truth related to who we are as human beings and not only a matter of learning (Øksnes, 2012).

CONCLUSION

Through a theoretical discussion of PBL, inspired by dialogues with a group of Danish university students and supported by a minor study conducted with the same group, this article investigates the role of play in PBL from two different perspectives. The study showed how play mediated a more honest and profound dialog between the students and their supervisor and through this meetings became more meaningful, fun and interesting for everyone. At the same time, the 'use' of play as mediator also led on to the foundation of a more trustful and courageous form of collaboration between the students and the development of a creative learning process or PpBL. PpBL is a term coined by Kiib in 2004 which sees play as a new entrance to the development of more creative students. In this article this is elaborated further and supplemented by a new model outlining three different knowledge forms related to PpBL (explicit, tacit and not-yet-embodied-knowledge) as point of departure for the discussion.

In the article, the underlying understanding of play in PpBL and the role of play in relation to the new knowledge-model is discussed thoroughly through the use of two terms – 'play-experience-learning' and 'play-experience-Bildung' (Øksnes, 2012). In play-experience-learning focus is on reflection-in-action and problem solving through Schön's perspective, whereas play-experience-Bildung is centered around the establishment of a more open, sensitive and wondrous approach to learning and 'what-is-to-come'. The latter opens to a more ontological and existential influence on students (Hansen, 2014; Käufer & Scharmer, 2007).

By bringing in play from the first meeting with the supervisor and through the establishment of a 'community of play' (Thorsted, 2014), the students seemed to get the needed confidence and courage to let go of their desire to be in control. They began to engage in the world more authentically and intuitively, which encouraged them try out new ways to approach the project and the learning process as a whole. We interpret this as an important step towards development of more creative students.

Given its small size, this study can only be regarded as a tentative study, pointing to directions for further investigations and discussions of a future pedagogic in Higher Education and more specifically the role of play in PpBL (PpBL). More extensive experiments with larger groups of students and different learning goals are needed to establish a more differentiated conclusion in the field.

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Outcomes-Based Authentic Learning, Portfolio Assessment, and a Systems Approach to 'Complex Problem-Solving': Related Pillars for Enhancing the Innovative Role of PBL in Future Higher Education

Cameron Richards *

ABSTRACT

The challenge of better reconciling individual and collective aspects of innovative problem-solving can be productively addressed to enhance the role of PBL as a key focus of the creative process in future higher education. This should involve 'active learning' approaches supported by related processes of teaching, assessment and curriculum. As Biggs & Tan (2011) have suggested, an integrated or systemic approach is needed for the most effective practice of outcomes-based education also especially relevant for addressing relatively simple as well as more complex problems. Such a model will be discussed in relation to the practical example of a Masters subject conceived with interdisciplinary implications, applications, and transferability: 'sustainable policy studies in science, technology and innovation'. Different modes of PBL might be encouraged in terms of the authentic kinds of 'complex problem-solving' issues and challenges which increasingly confront an interdependent and changing world. PBL can be further optimized when projects or cases also involve contexts and examples of research and inquiry. However, perhaps the most crucial pillar is a model of portfolio assessment for linking and encouraging as well as distinguishing individual contributions to collaborative projects and activities.

Keywords: problem-based learning; complex problem-solving; creative learning process; outcomes learning and research; interdisciplinary knowledge-building

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INTRODUCTION

Once described as a *foundation* or *linear structure*, knowledge today is depicted as a *network* or a *web* with multiple nodes of connection, and a *dynamic system* – Julie Thompson Klein (2004), Interdisciplinarity and complexity: An evolving relationship, *E:CO*, 6, 1, p.2

In the 21st Century in a fast-changing, complex and often difficult world of endless challenges and accelerating crises people have to increasingly deal with what many are calling 'wicked problems' (e.g. Kolko, 2011) – that is, complex problems without any obvious simple solutions requiring greater collaboration and the linking of different areas or disciplines of knowledge. In this way it is no longer good enough for universities to merely reproduce knowledge as merely surface learning or descriptive research (Trilling & Fadel, 2009). Problem-solving is the basic human impulse to actively engage in changing and improving human knowledge in the adaptation to changing global as well as local contexts of relevance and importance (Armstrong, 2012). On one hand this may involve science and technology responses to increasingly complex adaptations to physical environments. On the other hand, from rather a human or social science perspective this may also involve social, political and economic as well as the cultural as well as cognitive human contexts of communities, organizations, and whole societies trying to balance both internal imperatives and external challenges.

Philosophers such as Karl Popper and Bertrand Russell have long stressed the sophisticated ways in which problem-solving can or should be generally linked to the thinking process and methods of inquiry. However, as Socrates (whose elenchus method was a prototype for modern scientific methodologies) long ago pointed out, a problem-solving approach to thinking is one which is potentially open to anyone (or any learner) to negotiate the implications and omissions of the perpetual gaps between human knowledge and ignorance (Paul & Elder, 2004). In short, any kind of human problem-solving process is also inevitably a creative learning process – a key reason why formal education can be so readily transformed or effectively enhanced by problem-based learning approaches. The links between a systems perspective, the creative process and the problem-solving impulse in various forms of human knowledge were usefully described in Arther Koestler's (1963) model of the common structure of 'artistic originality, scientific discovery, and comic inspiration'. His *bisociation* model recognized that systems are always both part of larger systems and made up of endless smaller systems. In terms of human concepts, metaphors and perceptions such systems of representation are both internally open to transformation as well as also in relation to the knowledge of nature or adaptation to external challenges and environments. From an educational perspective this can perhaps be appreciated rather in terms of the interplay of *surface vs. deep learning* modes (e.g. Biggs, 1999) as a similar or related threefold creative process at distinct levels of form (or content), explanatory synthesis involving both cognitive

and social domains, and innovative solutions applied within particular contexts or transferable beyond this.

Problem-based learning (PBL) is a developing movement in international universities with interdisciplinary as well as specialist implications for a diverse range of disciplines and knowledge areas besides the medical schools where it originated as a formal method of using authentic cases (Barrows & Tamblyn, 1980). As a concept the term has been further adapted as a generic approach to active or constructivist approaches to learning in schools as well as universities (e.g. Jonassen et al, 2003). In this way it has been linked to related notions of self-directed outcomes (Biggs & Tan, 2011), critical thinking or inquiry (Paul & Elder, 2004), and also notions of the collaborative or social learning of 'communities of practice' (e.g. Wenger, 1999). However it is useful to consider how problem-based learning exemplifies what many call 'higher-order' and others 'deep-level' notions of learning applicable to practical as well as conceptual or theoretical domains. This is in contrast to the lower or surface notions of learning as the mere transmission, reproduction or even imitation of content in the form of information or basic skills (Bailley, Hughes & Moore, 2003). In this way as a model of active or constructivist learning and knowledge inquiry, PBL has long also exemplified the challenges and resistances to traditional educational models of exam-based assessment and an associated teacher-centred pedagogy as well as 'transmission' curriculum (Hmelo-Silver, 2004).

In this paper we discuss a systems approach to problem-solving in general as well as to problem-based learning in particular. In terms of how PBL exemplifies the possible links between formal education and the pivotal human capacity for problem-solving, we further discuss how this also presupposes a related systems approach to better integrating methods or designs of pedagogy, curriculum and assessment as well as the learning process. The discussion below will be organised around two related sections. The first section will look at the link between PBL and a systems view of the distinction between simple and complex problem-solving. The second section will use a practical example to discuss how PBL might be recognised and applied as one of three central pillars of 'active learning' in terms of an integrated application also to curriculum design, assessment methods, and the learning process. This example from a Masters program provides a focus for exploring the convergences between outcomes-based research and learning.

THE IMPLICATIONS FOR PBL OF A SYSTEMS VIEW OF THE DISTINCTION BETWEEN SIMPLE AND COMPLEX PROBLEM-SOLVING

Deriving in particular from Van Bertalanffy's (1974) model of general systems theory, various related models of systems thinking or science share in common an interdisciplinary approach to or perspective on the link between different areas of knowledge. Most significant

is how such theories or models are not only typically seen as applicable to both natural and human or social realms of knowledge but a means of linking what Bateson (1979) called the 'the necessary unity… mind and nature'. Thus the key concepts of an emerging paradigm of 'complex adaptive systems' and related models of complexity theory have also encompassed social or human domains of science as well as the physical sciences.

Such a paradigm has encompassed notions of feedback, emergence, self-organisation, and homeostasis or dynamic equilibrium in natural systems of physical matter, chemistry, and biology (e.g. Laszlo, 1972, Prigogine & Stengers, 1984, Mandlebrot & Hudson, 2005) on one hand, and on the other corresponding notions of life cycles, supply chains, and change dynamics in various forms of human organization involving complex social, economic and cultural imperatives (e.g. Forrester, 1991; Barratt, 2006). The related importance then of multi-disciplinary collaboration and interdisciplinary problem-solving (Klein, 2006) to complement rather than oppose content knowledge specialization is thus reflected by how human organizations also function as naturally complex adaptive systems in relation to changing environments (e.g., Mitleton-Kelly, 2003). In other words, there is a natural connection between systems theory and the inevitably interdisciplinary as well as interdependent requirements of complex problem-solving in and across all areas of human knowledge (Fauconnier & Turner, 2002).

Scientific and other models of knowledge are often viewed in terms of mere data and information accumulation but the human capacities for observation and reflection as well as experimentation in relation to new or changing contexts are clearly more effective when framed as focused problem-solving of some kind. This is so in relation to how a problem is perhaps most usefully defined as a 'perceived gap between the existing state and a desired state, or a deviation from a norm, standard or status quo' (Business Dictionary, n.d.). A systems approach or perspective allows recognition that all human problems either directly or indirectly involve systemic complexity – even apparently simple problems. In contrast to the tendencies of superstition (confusions of wholes with some of their parts) and various forms of typically de-contextualized or modern modes of positivism, reductionism and 'either-or' thinking (which reduces wholes to the sum of their parts), systems theory focuses on the interdependent as well as independent relation of wholes and parts in and across distinct systems in terms of the processes of interaction, change and transformation.

As we have put it elsewhere (Richards, 2013, p.6):

> *Simple problems (e.g. a bacterial infection, a clogged up fuel filter, or a personality clash within a business organization) which may initially seem more serious and complex might well be quickly addressed and efficiently resolved. However good doctors, mechanics, and leaders all know that both simple and complex problems are all ultimately about restoring the natural and deep-level*

efficiency or health of a particular 'system' whether this be a patient, a car or a business organization. As the wicked problem concept illustrates, the world of actual human experience and organization as well as all nature generally is ultimately and intrinsically complex, interdependent, and open to perpetual change. Superficially 'simple' problems ever conceal a latent complexity, yet ostensibly 'complex' problems are ultimately quite simple in principle.
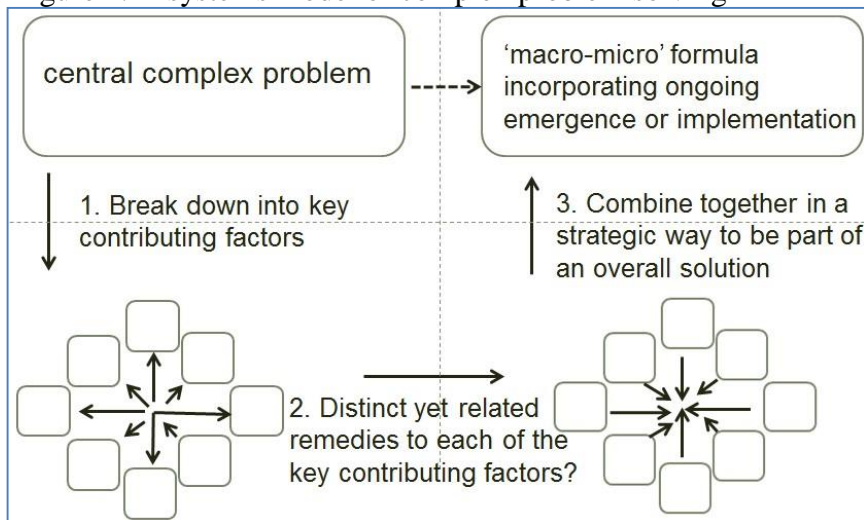
Figure 1. A systems model of complex problem solving

Figure 1 outlines a systems model of complex problem solving we have developed and used to assist the planning of students in the course discussed below. It represents the three basic stages of addressing a complicated, difficult, and even an apparently impossible problem or challenge. Assuming that it has been established that we are dealing with a systemic or complex and not just superficial challenge or minor issue, the foundation stage then is to recognize and prioritize the various aspects of an identifiable problem of some kind. The main aim at this stage is to identity the key factors which might include both internal and external aspects, factors and 'variables'. The second stage involves investigating and coming up with possible distinct remedies to each of the main contributing factors, as well as some macro remedies to the main problem. The third stage then is to consider an overall formula which makes use of also distinct 'contributing solutions'. Such a synthesis will also consider how these supporting remedies might combine together in a strategic way to be part of an overall solution. As well as combinations of parts in space any overall solution must also incorporate the process of time to anticipate obstacles to any plan as well as productive interventions and requirements of implementation. The three stages also correspond to Ricoeur's (1994) hermeneutic arc of an initial situation or 'naïve' awareness giving way to critical or explanatory deconstruction then followed by an applied or dialogical stage of synthesis, reconstruction, or transformation.

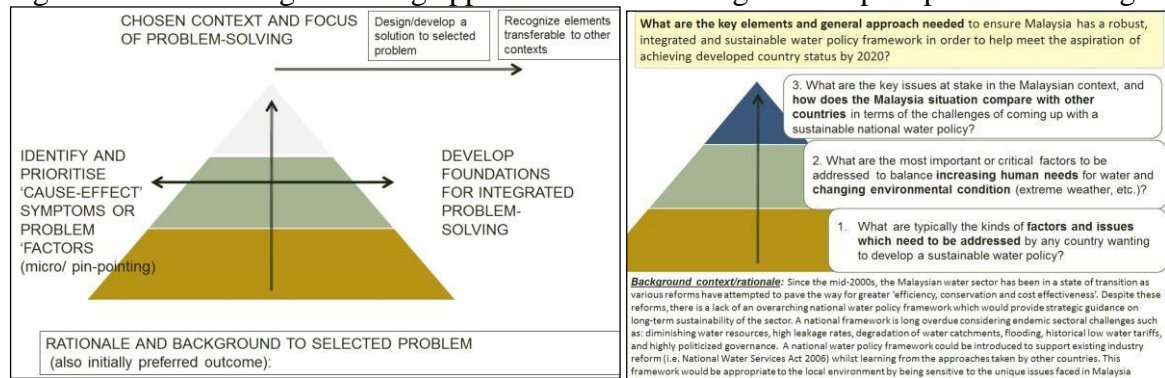Figure 2. A knowledge-building approach to the challenge of complex problem-solving

Figure 2 further outlines an example of emergent *outcomes-based* rather than merely retrospective or rationalist *evidence-based* inquiry and problem-solving. It adopts the constructive version of the applied or dialogical hermeneutic 'law of three' to outline a practical example of formulating a framework for addressing 'wicked problems'. The initial phase involves achieving a provisional or working foundation. On this basis a second stage seeks to prioritize the various relevant internal and external factors or contributing problems. Following on from or simultaneous to this, a third phase seeks to develop an emergent and convergent solution. The implied strategy then is to 'optimize' the problem-solving process in terms of transforming any relevant data and information into applied knowledge and understanding. As the right-hand diagram in Figure 2 illustrates, an integrated, optimal and sustainable approach to addressing a central or focus problem can be designed in terms of a knowledge-building structure which establishes a relevant foundation, is able to progressively prioritize related issues, and further facilitates not only the acquisition of data and information but its transformation into useful knowledge.

This might be appreciated in terms of recognising the interplay of internal and external axes of inquiry which together constitute the so-called *data-information-knowledge-wisdom pyramid* (see Figure 3) used in such areas as 'management information systems' (e.g. Fricke, 2009). In such applications 'wisdom' is typically seen as unknowable or referred to only ironically. The accumulation and description tendencies of an *external axis* of empirical data and organised/rationalized information is redeemed or open to be transformed in terms of some focus outcome in relation to an *internal axis* of knowledge, experience, and understanding. In this way 'wisdom' need not be an accidental by-product or outcome of accumulation and complexity but actually a deep foundational process based on the quality of experience, understanding, and interpretation not just quantity of information (Richards, 2011).

Figure 3. Thinking for problem-solving - the basis for transforming emergent databuilding into productive knowledge-building
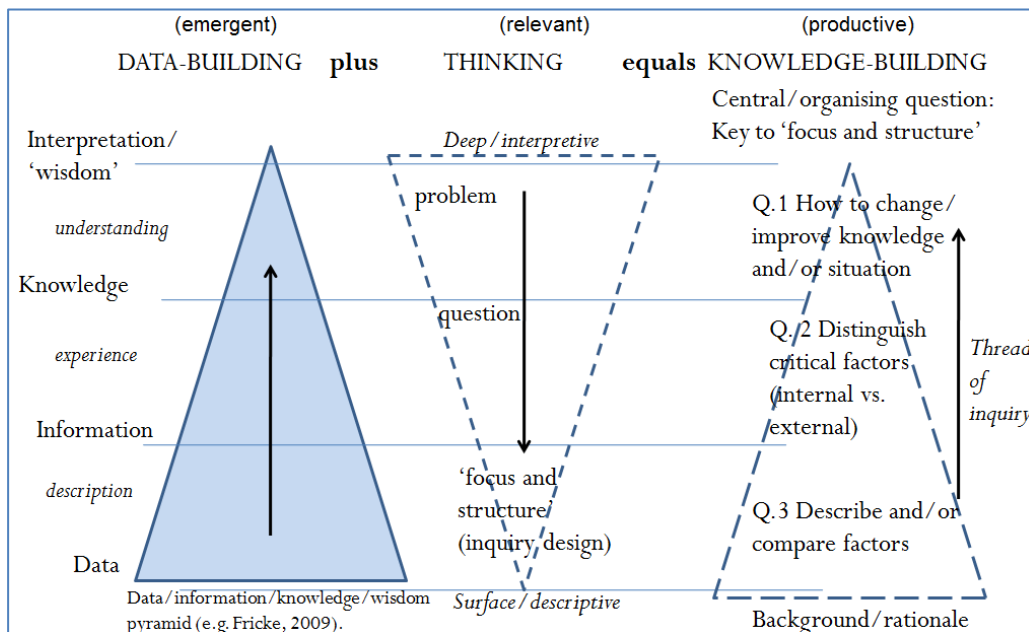

Figure 4 outlines a model for a paradigm shift from the linear and hierarchical assumptions of transmission and related reproductive learning models which tend to focus on the surface acquisition of skills or information. It further projects how an outcomes-based education approach aims to encourage deep learning outcomes associated with active or constructivist learning models (Spady, 1993). Unfortunately this is often understood or applied as a merely hopeful anticipation of the future often inadequately supported as an actual process of emergent knowledge building. As Biggs & Tang (2011) have pointed out, a really effective outcomes-based education approach works backwards from concrete notions of proficient and transferable performance in specific contexts to emphasize the crucial elements of pedagogical, curriculum and assessment design to support this as an actual process of emergent knowledge building. In this way also, we find it useful to make the distinction between conventional 'learning objectives' curriculum design and teaching on one hand, and on the other a truly 'outcomes-based' approach. This may be explained in terms of a related distinction between golf hackers who aim for the flag in a merely hopeful way (a vague or hopeful objective) and those try to align their game with a concrete visualization of the required length, direction and trajectory (clarify, frame, and 'work back' from a specific outcome) for the ball to 'go in the hole' as many golfing coaches now teach professionals (Gallwey, 2009). For outcomes-based education to work properly, learning activities need to be sufficiently aligned in practice with the process not just metrics of assessment or evaluation. Likewise the formative aspects of the assessment as well as learning process need to be sufficiently encouraged and also aligned with the rationale and framework of summative assessment procedures. This is why project work and other 'culminating' modes of learning activity are so useful in facilitating more systemic or deeper modes of learning.

Figure 4. How outcomes-based education should 'reverse' not reinforce conventional and surface modes of transmission learning
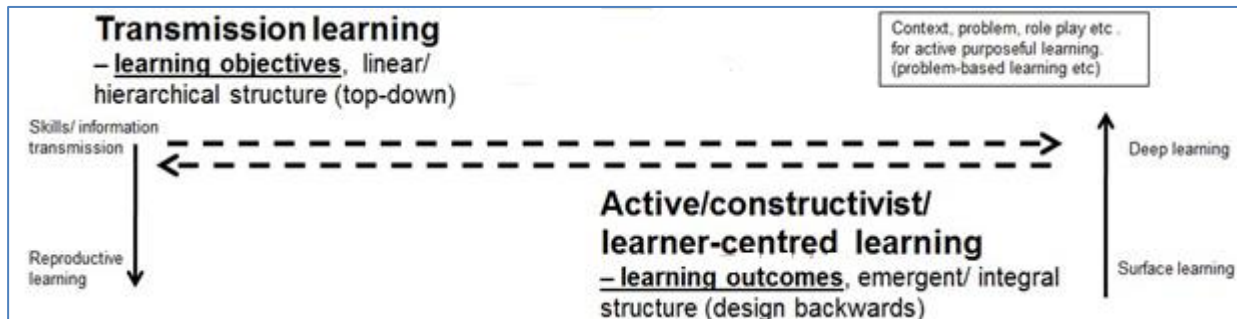
As indicated above, active or constructivist models of deep learning also often and generally emphasize an associated alignment of related axes of critical thinking and applied performance when building upon or transitioning from merely 'surface learning' modes. This is why exams may well remain a useful part of an integrated assessment strategy and should not be seen in an either-or relation to project work, assignments, and related modes lending themselves to encouraging active or constructivist learning. We have also elsewhere argued that related models of problem-based learning, inquiry-based learning and project-based learning represent the three key pillars of the various permutations of active or constructivist learning (Richards 2004). This is in part on the basis that these models also link together in ways that correspond well to the action learning (and 'double loop' learning) cycles of David Kolb, Donald Schon, and others (e.g. Kolb, 1984). Moreover, problems, questions and tasks framed in authentic or imaginary contexts of learning activity lend themselves to a related alignment between formative and summative assessment as well as of surface and deep aspects of the learning process. Notions of surface learning are typically associated with the reproduction of information or skills whereas deep learning is a mode of optimal performance or applied understanding transferable across different contexts (e.g. Biggs, 1999).

Figure 5. The three pillars of active or constructivist learning translated into an emergent learning-assessment framework
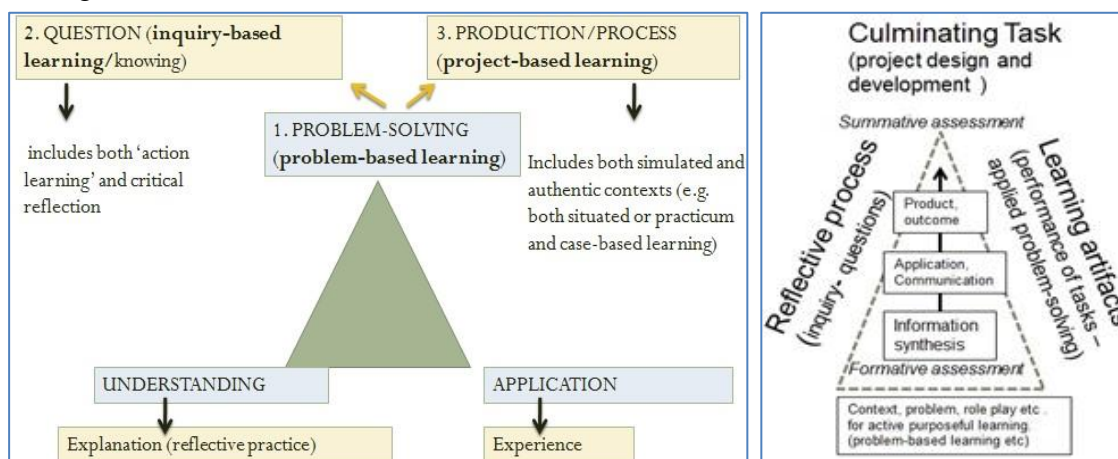
The right-hand diagram in Figure 5 thus depicts how a culminating learning task or activity provides the focus and structure for developing a foundation for optimal and sustainable learning application or performance on one hand, and on the other a macro-micro interplay of ideas and language aspects synthesized in any creative thinking process. The left-hand diagram correspondingly suggests how a three pillars model of active learning also reflects Ricoeur's dialogical model of three distinct stages in emergent knowledge-building – a naïve stage (*identifying and/or posing a relevant problem*), a crucial stage (*translating this into a focus question*), and an applied or dialogical stage (*building knowledge or achieving deep learning as a an emergent phase of project development*). Thus applicable to any model of the transition from surface to deep learning is Ricoeur's (1994) related theory of innovation. It posits that ultimately any human performance or communication of meaning can either potentially or actually go beyond (surface) learning as accumulation or linear progression to creatively open up existing social as well as personal or individual structures to transformative change or improvement.

There are different applications of PBL in different areas of knowledge or for distinct outcomes. Some versions of PBL are promoted in terms of specific cases involving specialized knowledge (e.g. the use of PBL cases in medical education) whereas as others espouse interdisciplinary or 'across-the-curriculum' collaborative learning (Jonassen, et al, 2003). However, either directly or indirectly PBL designs or approaches can most effectively enhance learning where some form of 'problem-solving' is linked to an alignment of focused outcomes and meaningful culminating activity. As Kolb (1984) suggests, the most effective cycle of learning involves active experimentation linked to concrete experience as well as to related processes and stages of reflective observation and abstract conceptualization. In related fashion, models and practices of PBL can and should replicate the applied problem-solving experimentation in the natural and also medical sciences as well as the thought experiments of the human and social sciences. In other words, it might be suggested that the most effective convergent notion of PBL is typically conceived in terms of either authentic or imaginary 'problems' framed in a variety of ways including cases, scenarios, questions, challenges, issues, and so on.

As Biggs & Tan (2011) outline, outcomes-based learning and assessment should be *constructively aligned* to provide a supporting framework designed to assist learners to achieve specific learning outcomes aligned with various activities and processes of active or constructivist learning. Inadequate applications of the outcomes-based education model tend to merely confuse outcomes with objectives and also ignore how there should be a crucial as well as constructive alignment of meaningful and effective outcomes with not only learning activities and processes but the formative as well as summative process of assessment. The conventional view of lesson-planning, syllabus design, and curriculum development has tended to emphasize linear and hierarchical content-focused models of skills or information acquisition. But active learning models rather emphasize the importance of interesting and

engaging *introductory contexts* which also link to a process of knowledge synthesis and application in *examples* (or cases) – emphasizing the importance of an integrated process of learning which also links reflection and activity. Thus a systems view and application of outcomes-based education should promote assessment *for* and not just *of* learning. It should also provide an integrated and structured educational but also inquiry 'space' (and not just classroom 'environment') for the emergent of effective learning as both understanding and explanation in terms of an effective linking also of *macro level* concepts, attitudes and general knowledge together with more *micro level* skills, content and detailed modes of knowledge. Good teaching and curriculum design should promote and encourage deep and not just surface learning transferable to other contexts. A systems approach, then, is particularly useful in promoting different yet related modes of deep learning.

WICKED PROBLEMS AND POLICY-BUILDERS OF THE FUTURE? CURRICULUM AND ASSESSMENT DESIGNS TO SUPPORT AUTHENTIC PROBLEM-BASED LEARNING FOR AUTHENTIC POLICY CHALLENGES OF SUSTAINABILITY

PBL has been particularly discussed above in terms of its application to promote assessment *for* and not just *of* learning. Various kind of authentic or imaginary learning 'problems' can either directly or indirectly encourage and support an associated mode of effective outcomes-based learning. We discuss below a recent example where we had the opportunity to apply a systems approach to teaching, curriculum and assessment within a completely new course. The module *MFT1053 Sustainable STI Policy Development* was unexpectedly added at the last moment to the initial 2012 offering of a new Masters program (Richards, 2012). Short notice was received to conceive and develop this. However it was clearly a course which lent itself to a PBL approach with its focus on the challenge of sustainable policy studies linked to the similarly important concept of 'science, technology and innovation' (e.g. Christensen, 1997, Meissner, Gokhberg, & Sokolov, 2013).

We will discuss below three aspects of how we applied a PBL framework relevant for this particular course in relation to a similarly 'systems approach' to encouraging an authentic problem-solving orientation for authentic purposes linked relevant or possible cases, challenges, and issues which students could choose to focus on. The first section will outline how students were required to undertake a course project in pairs where they needed to identify, address and design a possible working solution to some distinct and authentic problem related to issues of sustainability also linked to aspects of science, technology and innovation. The second section will discuss how this was encouraged and framed in relation to a digital portfolio assessment context also involving related reflections and activities done individually to reflect, support and link to the culminating project and the related achievement of projected course outcomes. This involved an innovative yet effective assessment framework applied as a mark-sheet which, for space reasons, could not be included here. A

third section indicates one of many conceptual tools used in this class which epitomizes an outcome-based approach to 'integrated, optimal and sustainable' complex problem-solving.

Designing a problem-based learning project task in sustainable STI studies

The integrated program of teaching, curriculum and assessment in this course was built around the student development of a project involving a relevant focus problem. The classes of MFT1053 were conducted as a set of regular presentations linked to related tutorials. In addition to weekly presentations on course topics, each week students were required to individually present seminars on a topical new case of a policy problem authentically derived from the local newspapers. In this way they were asked to identify interesting and exemplary STI-related policy problems of sustainability and also came up with initial suggestions of possible solutions. These presentations then were linked to tutor-lead discussions, and online as well as face-to-face class activities. For their presentations as for their main project, students were expected to produce a 'knowledge-building pyramid' which consisted of the translation of their chosen policy problem into an inquiry rationale as the basis for also identifying and engaging with a central question in terms of three supporting questions which might structure the inquiry towards emergent solution options. This regular linking of practical, interesting and authentic cases to aspects of theory, evaluation and the construction of design solutions became the foundation for students to later take on a more developed project which functioned as a culminating task synthesizing the stages and aspects of sustainable policy development as complex problem-solving in this particular subject.

Figure 6. Summary overview version of MFT1053 project task

MFT1053 Science, Technology and Innovation Sustainable Policy Development
Project - STI Case Study in sustainable policy-building [revised]   40%
Class topics and activities will aid with the skills, knowledge and procedures to undertake a detailed case study of a chosen topic. Students will be asked to structure their project around provided templates which will assist to develop two stages of STI policy-building: (a) identifying a particular STI Policy challenge, issue or problem, and (b) outlining a provisional strategy of sustainable planning or decision-making to address this. The project may be developed as a collaboration in pairs harnessing the power of cooperation and team-work as well as individual insight and applications. The chosen example should have at least some indirect connection to an aspect of focus of 'science, technology and innovation' and also the need for some kind of policy-building collaboration between organizations or interests from government, private/commercial, community and/or university (R&D) domains. For instance…
1. Exemplary higher education – industry – government – society collaborations involving both aspects of (a) science and technology and (b) sustainable policy-building implications.
2. **Authentic social and/or environmental issues, problems and challenges** which might be most effectively addressing with an integrated approach to linking 'science and technology' to knowledge management or organizational strategies of planning and decision-making
3**. Harnessing and applying existing science and technology** to address social and/or environmental challenges or problems (and/or associated economic challenges/business opportunities)
4. **Exemplary instances of cutting edge/future 'science and technology**' (bio/nano-technology, renewable energies, digital technologies, etc.) with sustainable policy-building implications (e.g. green technology, sustainable development, innovation economy, & commercialization of research) *General Criteria: project development, teamwork (if done in pairs), case study analysis and application, innovation of policy solutions, demonstration of 'sustainable' policy-building,*

Figure 6 outlines how students were provided with options and supporting templates to support the development of their project inquiry in terms of three stages and corresponding parts of their required project write-up: (a) identify a brief rationale, background and supporting inquiry structure to address the selected policy issue or challenge; (b) critically break down a central problem of selected policy issue into main contributing aspects, elements and factors, and (c) design and outline a proposed sustainable solution which would simultaneously address contributing challenge and central problem. The PBL project was expected to build upon the course foundations of 'sustainable STI' knowledge, case studies, and applied problem-solving. In this way it should represent a culminating activity of the overall course encouraging students to synthesize and apply what they have learnt so far in terms of projected key course outcomes.

As indicated, sustainable policy studies linked to the emerging field of science, technology and innovation includes options which range from more specialized perspectives to interdisciplinary modes of complex problem-solving. Students were provided with models and templates to assist with this in terms of a how a sustainable problem-solving framework typically involves four distinct aspects and requirements or elements of integrated problem-solving and policy-building reflecting corresponding modes of human knowledge: 1. (communication, consensus and interdependence of) *stakeholder perspectives; 2. knowledge management* (of organizational vs. niche/individual/local human resources and performance) 3. *science and technology innovations* (applied knowledge building as extension); and 4. *complex environmental adaptation* (to changing natural vs. socio-economic contexts in time). These aspects provide the focus for outcomes-based problem-solving geared towards the 'optimization' of natural and human resources, an innovative as well as green approach to new science and technology solutions, and the process of achieving a foundation for sustainable 'change and improvement' in terms of a sufficient consensus of common purposes. As outlined such an approach requires a systemic alignment of the distinct if ultimately convergent axes of human knowledge-building. Students did not directly apply this framework in their projects but could use it to develop their selected problem focus in relation to the provided options.

Activity-reflection e-portfolios as an overall 'culminating task'
As the culminating course task of problem-based learning, the MFT1053 project undertaken was also part of an overall e-portfolio assessment framework supported by a range of supporting individual reflections and activities. These had a formative as well as summative purpose in allowing progressive feedback to students about their achievement of course outcomes. The concept of an activity-reflection e-portfolio (Richards, 2005, 2013) builds on Kolb's notion that the most effective learning is that which constitutes an interplay of thinking and doing involving meaningful tasks to also harness the power of digital media to support such learning. As suggested earlier, the possibilities of achieving 'active learning' modes as an extended process across a particular syllabus or academic context are most fully realized in

various kinds of project-based learning which involve the notion of a 'culminating task'. In various forms of problem-based and inquiry-based learning conducted as an authentic task or even as imaginary role-play and scenario, the notion of a culminating task of assessment synthesizes as well as supports an educational 'ecology' of targeted or projected outcomes linked to a central outcome or culminating task. Whilst the presentation of some kind of portfolio of reflections as well as applied learning tasks can be sufficient in itself to encourage this, the most effective curriculum framework for such optimized learning is to construct some particular project outcome.

Figure 7 below illustrates a sample activity-reflection e-portfolio from the MFT1053 course. In this particular course the e-portfolio involved a simple Word document saved as a html file with a hyperlinked file. Nonetheless it still provides a comprehensive and accessible learning profile in terms of formative as well as summative purposes tracking and archiving the related reflections and activities supporting the main project. Students are typically encouraged to develop such a profile into a professional e-portfolio beyond the purposes of the course. For assessment as well as feedback purposes, the e-portfolio further comprehensively maps and archives evidence of the outcomes achieved in the course. In particular this was organised as a mark sheet providing a portfolio of critical feedback in relation to key items whilst also applying a a formula for reconciling rubrics and criterion-based assessment and likewise converting qualitative indicators into an overall quantitative ranking.

Figure 7. Sample activity-reflection e-portfolio profile from the UTM MFT1053 class

Students were expected to submit regular reflections in response to provided focus questions throughout the semester. They did this by email in this particular course but could have

uploaded to an e-learning content management program. In this format they receive feedback and have the option to respond to this in the final version of the e-portfolio. In this course the series of reflections supported both the development of their main project and supporting activities. For instance, the Week 5 reflection asked students to respond to the following:

> *Wk 5: 1. As various examples from the newspapers show, STI policy-building often takes places in relation to industry – government – society collaborations which may also involve universities (especially for R & D and education/training). A focus of this week's class is to look at the challenge of achieving sustainable collaborations. Briefly discuss how a more sustainable public-private sector collaboration might be needed or achieved in relation to either the smartphone or water industry examples discussed in class*

Students undertaking the MFT1053 course received weekly opportunities to consider possible solutions to authentic case studies in the challenges of achieving sustainable STI-related policy solutions. They were encouraged to adopt an outcomes-based problem-solving approach which thus lent itself very appropriately to the outcomes-based learning and assessment approach adopted within the educational framing of the course. As outlined in the first section of this paper this involved approaches which not only would seek to break down complex problems in terms of their key contributing factors but also consider possible outcomes solutions and the issues of integration and implementation which would be needed to support these. One such model applied which also integrated some of the key aspects of sustainable knowledge-building promoted in the course is outlined below. The enneagram model of 'integrated, optimal and sustainable' complex problem-solving promotes the notions of transformative as well as sequential or cumulative stages of inquiry. But it also provides an exemplary framework for designing an outcomes approach to problem-solving in terms of a systems perspective and model.

'Integrated, optimal and sustainable' complex problem-solving: The enneagrammatic structure of any deep-level creative process

The enneagram model represents a particular knowledge-building tool or method deriving from the Pythagorean tetractys which in its more recent adaptations has also been used for purposes of promoting effective organisational learning, strategic leadership, and applied decision-making as well as the integrated study of personality types (e.g. Riso, 1987; Blake, 1996; Knowles, 2003). Such adaptations derive from the work of J.G. Bennett (1983) who saw the enneagram as an exemplary model of the complex (i.e. whole-parts) dynamic of the creative process.

As we have also discussed further elsewhere as part of a special journal edition focus on the transformative applications of the enneagram for organizational and other learning (Richards, 2013), the enneagram also exemplifies the generic structure of natural and human systems of knowledge. The intrinsic properties of the enneagram represent a linking of both geometric progression and a 'transformational' view of numbers in terms of the Pythagorean conception of the base 10 system. The triangular relation of the 3-6-9 numbers representing integration, optimization, and sustainability frame the 1-4-2-5-7-8 sequence which also is the intrinsic decimal pattern of any seventh fraction. Our representation here links to a number of related terms of sustainable policy and knowledge building – notions of a 'threshold of change', a 'corridor of emergence', and the challenge of achieving a 'dynamic equilibrium'.

Figure 8. The enneagrammatic formula of integrated, optimal, and sustainable problem-solving
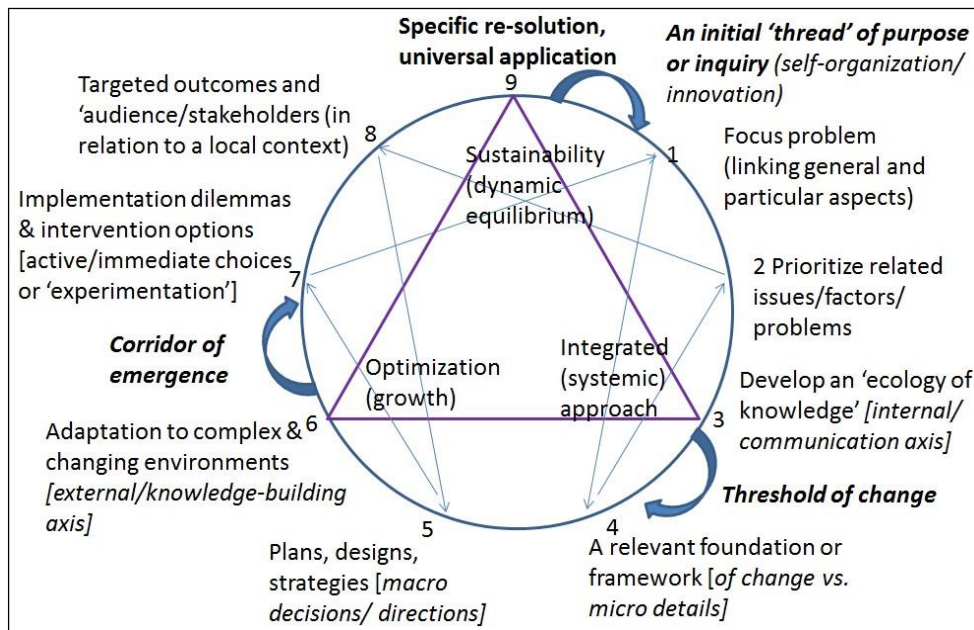
Adapted from Richards, 2013

However our interpretation of it here as a model for linking the related notions of resilient systems thinking, applied problem-solving, and the creative process of human knowledge-building also usefully represents two linked systemic stages of outcomes-based knowledge transformation. As Figure 9 indicates, the enneagram functions as an exemplary model of how self-organizing systems (especially those involving complex adaptation to changing contexts) typically involve internal or external axes of constructive alignment. In human social groupings and organizational dynamics this involves interdependent functions of accountability or self-organization and negative vs. positive feedback loops which converge to inform a resilient as well as transformational creative process. The related right-hand diagram indicates how it usefully exemplifies the corresponding processes of learning and

inquiry. A new paradigm of integrated, optimal and sustainable problem-solving in learning thus involves the emergent, deep-level, and higher order processes of optimal knowledge-building, reflected in the interplay of both macro and micro learning processes and outcomes. It thus exemplifies the potential of the most effective problem-based learning designs and structures in scientific inquiry, artistic representation, and an innovative performance of any practical skill or conceptual knowledge in context (Cf. also Pledge, 1983).

Figure 9. The enneagram and the convergent axes of 'unity' which inform optimal human knowledge-building
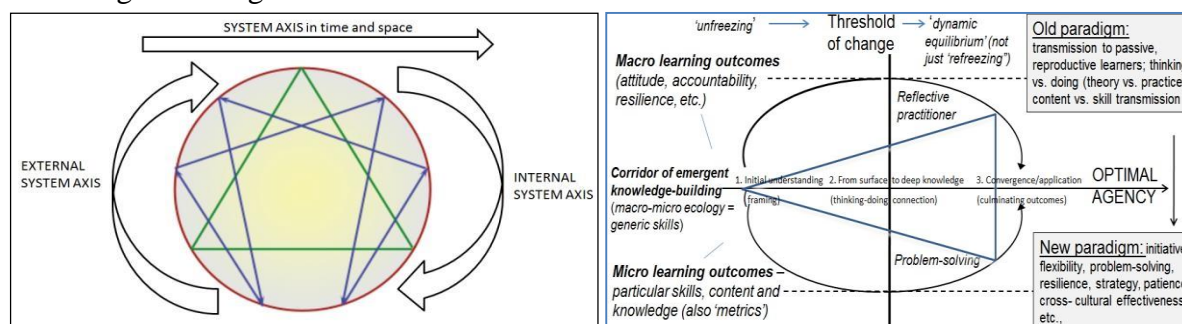
Adapted from Richards, 2013

CONCLUSION

This paper has focused on how the natural human imperative for problem-solving in terms of adaptation to social as well as natural environments provides the key to the most creative as well as effective learning, inquiry and also knowledge-building research (Powell & Ryzhov, 2012). It has discussed how the increasingly influential concept of problem-based learning has evolved in recent decades from its particular use in medical education for studying authentic cases to an interdisciplinary central pillar of the active or constructivist learning paradigm in schools and universities. The influence that a convergent PBL model has had on encouraging enhanced collaborative inquiry and problem-solving in professional as well as academic and even technical or competency-based education is also one that can and should be replicated in terms of more interdisciplinary, collaborative and outcomes-based (and not just evidence-based) inquiry within and beyond university contexts of partnership. After all, University students should ideally also learn in terms of active modes of thinking and knowledge-building applicable to both authentic real-life contexts and the additional university purpose of encouraging and supporting effective research in various senses of the term.

A general model of PBL in primary and secondary education has typically encouraged cross-disciplinary collaboration and knowledge sharing (i.e. it is common for members of school

problem-based learning projects to take on different roles, purposes and modes of knowledge-building). This has not typically been the case in higher or continuing professional education contexts where the emphasis is often on specific cases in terms of specialized knowledge. The paper has developed an argument that a convergent model of PBL exemplifies as well as encourages the kind of approach needed to address the increasingly complex and diverse 'wicked' problems facing the world in every aspect of both the social and natural domains of human life and activity. Thus the final section of the paper has outlined the cross-disciplinary inquiry implications of how a generic model of complex problem-solving systematically proceeds in terms of a basic three-stage method: (a) breaking down overriding or central problems into their main contributing domains and factors; (b) also focusing on these domains and factors separately as well as together in terms of seeking feasible or recommended supporting solutions, and (c) building towards an overall strategy and proposed integrated solution in terms of a systemic approach which reflects 'the whole as well as the sum of its parts'. The further discussion of the *enneagrammatic* dynamics of 'integrated, optimal, and sustainable problem-solving' has served to exemplify the possibilities of an integrated systems approach to problem-based learning as well as the generic problem-solving process in every aspect of both social and natural domains of human knowledge.

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Problem Solution Processes of Musicians and Engineers: What do Their Approaches Look Like?

Säde-Pirkko Nissilä, Esa Virkkula ∗

ABSTRACT

PBL is learning through becoming conscious of practical and abstract problems and finding ways how to solve them. It can be a pattern which doesn't follow traditional divisions of disciplines. In this article the material was collected from two, in the first sight, very different groups. One was music students (N = 62) who had to learn to solve various practical and theoretical problems in preparing a program for a series of concerts as collective and individual action. The method used was the 7-step method which divides learning into seven phases proceeding from creating the social frame of reference and mental models (steps 1–4) through actual work (steps 5–6) to the evaluation of the outcomes (step 7). Another group consisted of international, multicultural business leaders in engineering (N = 6). In using earlier the 7-step method, the approaches resembled those of the music students: deepening their professional competences. To engage their ability to use imagination and connect reality with brainstorming and mental flexibility, the creative PBL method 635 was used. Three practical problems were solved so that the solutions included new viewpoints which would be applied to meet the real needs in the near future. The results show that not only were the learning targets of both groups reached but, with reflection included, the processes widened the professional competences of the participants.

Key words: 7-step method, 635-method, creativity, rationality, innovation

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INTRODUCTION

The purpose of a higher education system is to foster and encourage scientific competencies and promote progress. In the terms of creativity and expertise this is a hard challenge. Undertaking teaching activities in higher education requires competence, flexibility and future orientation (Ellström, 1998; Ellström & Kock, 2008; Karjalainen & Nissilä, 2011).

The source of complexity in teaching comes from the concept of learning. The level of learning always varies and the teacher should be able to reflect on the variations. How to teach in such a way that the students' learning outcomes surpass the knowledge of the teacher? This conception may be the eventual aim of higher education. The central mission of teacher education in Finnish schools over the past 30 years has been that of research-based professionalism (Westbury, Hansen, Kansanen & Björkvist, 2005).

Reflection is aimed at helping students and teachers to develop multiple goals and encourage transformative development. Transformation is not one significant emotional event; rather it is a series of experiences which teach critical thinking whereby reciprocal processes enable the students and teachers to construct meanings (Mezirow, 2009; Nissilä, 2006, p. 237–239).

Learner and teacher autonomy and pedagogy may be seen as interrelated and interdependent concepts, if their meanings are deeply analyzed and interpreted. There are two assumptions: first, that there cannot be any 'real', genuine pedagogy, in the proper sense of the word, without the autonomy of the teacher, without his/her freedom in decision-making and action; and second, autonomy of a teacher does not lead to what is educationally worthwhile or educative, unless it is backed by pedagogy, by a teacher's pedagogical consideration and tactfulness (Lauriala, 2002, p. 131–132; Nissilä, 2002).

Problem-oriented education emphasizes dealing with the learning targets so that a learner can integrate the necessary theoretical and practical knowledge into the learning processes. As the outcomes of integration they will gain experiential knowledge which is permanent by nature when compared to rote learning separated from practice or to experiences without theoretical basis (Savery, 2006). It is a teacher's duty to find challenges which are relevant, interesting and sufficiently many-sided from the viewpoint of the student's learning, (Barrett & Moore, 2011), to facilitate learning and develop learning environments which support reflective learning (Andreasen & Nielsen, 2013).

In various studies the importance of a student's participation has been underlined in planning, implementation and evaluation of the outcomes (eg. Andreasen & Nielsen, 2013; Barrett & Moore, 2011; De Graaff & Kolmos, 2003; Illeris, 2009; 2011; Savery, 2006). Consequently,

Bridges & Hallinger (1992, p. 9) emphasized three conditions created within PBL environment. They are linked to subsequent retrieval and appropriate use of new information, these being: 1. activation of prior knowledge; 2. encoding of knowledge in a specific context and 3. opportunity to elaborate on that information.

In addition to cognitive rationale, social-psychological theory also provides conceptual support for inquiry links between modes of instruction and the learning of various skills. Social comparison of ability is prevalent in and central to group members' assessment of self and the others (Bridges & Hallinger, 1992). Social consideration is also needed when using PBL in administration. There is an ethical perspective that needs attention. Especially in the case of multicultural administration the culturally bound practices and ethics must be understood. Ethics is about our relationships with others (Singer, 1994). It can also be viewed as a 'philosophy of morality' as it deals with ought and ought not (Mahony 2009, p. 983). It can be seen as prescriptive rather than descriptive, since ethics is concerned with what we ought to do. According to a research (Helton & Ray, 2005) ethical dilemmas can arise from administrative decisions conflicting with personal and professional ethics.

Because of the responsibility for ethical dilemmas which are present in HE teachers' and students' as well as engineering management's daily work, careful preparation for a PBL design is necessary. PBL is expected to provide also for this aspect in its cognitive, social-psychological, open and group-oriented approach.

PBL SEVEN STEP -METHOD

The aim of the seven steps PBL method was in the present cases to promote the students' learning through real-world problems. A special attention was given to the context of learning, to activating the students to promote their learning and to an opportunity to elaborate on their knowledge (Schmidt, 1983, p. 15).

According to De Graaff & Kolmos (2007) in a stepwise process the experiential and cooperative are followed by reflective evaluation and assessment. Learners observe work situations, pay attention to the contents and quality of working and, on the other hand, assess their own roles in the outcome of action. In addition to substance matters, PBL requires the learners' communication and good cooperation to serve the shared goal.

The seven steps method has been applied for example in the fields of educational medicine and health science (Eitel & Steiner, 1999; Matheson & Haas, 2010; Yun Du et al., 2013), teacher education (Murray-Harvey, Pourshafie & Santos Reyes, 2013), engineering (Lai et al., 2004; Nuutila et al., 2005; O'Shea et al., 2013) and hospitality management (Zwaal & Otting, 2010). In the research results (e.g. Dolmans et al., 2005, p. 732–733; Maudsley, 1999;

Nowrouzian & Farewell, 2013; Savery, 2006; Schmidt, 1983) the characteristics of PBL in general appeared to be learners' activation and motivation, goal-oriented working both individually and communally, real-world problems, lifelong learning skills and the change of the supervisor's role from a traditional lecturer to facilitator. Learning was not sought by sharing information but activating students to do many-sided learning tasks and reflect on their action.

Problem solution is based on a stepwise process which proceeds from the definition of the problem to analyzing, solving and reflecting on what happened. According to Schmidt (1983, p. 13) the seven phases of problem-based learning are: 1) clarifying the terms and concepts which are not readily comprehensible, 2) defining the problem, 3) analysing the problem, 4) inventory of the explanations inferred from step three, 5) formulating learning objectives, 6) collecting additional information, 7) synthesizing and testing the acquired information.

The method has later been reinforced by emphasizing the importance of learning in the process. Central additions have been the reflection of the problem cooperatively, defining individual and joint goals of learning as well as the evaluation of learning outcomes and assessing the problem solving process from the viewpoint of learning (e.g. Maudsley, 1999; Savin-Baden, 2007; Wolff, 2000).

PBL 635-METHOD

635 projects are often a path to smaller or larger innovations, on the way to something that is somehow new. In organizations and groups of learners there are barriers that stop creativity. These barriers are to be discussed and efforts made to remove them (Kanter, 1983). 635 is connected to the use of human resources, quality management, risk management, planning and sometimes control. The aim of removing barriers is to increase creativity in everyday practices.

What is actually creativity? Robbins and Coulter (2007) defines it as the ability to combine ideas in a unique way or make unusual associations between ideas. The essential characteristic is newness. Anyone can be creative, if the attitudes are not too critical. The techniques of creativity 635 method are often referred to as brain writing. To release one's creativity may be risk-taking. The process can be as figure 1 shows:
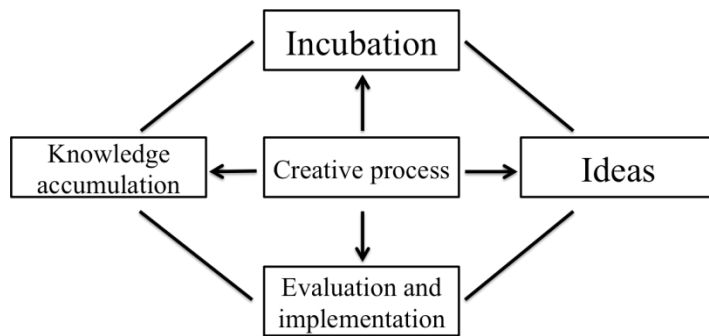
Figure 1. Kuratko and Hodgetts's (1995) description of creative thinking process.

In the brain writing process, in 635, something incremental is sought for, for instance a new way of perceiving something that was already in existence and can still be highly profitable. The intention may be to improve the quality of service and respond to the customers' expectations. It is understood that innovation usually leads to better performance (Kanter, 1983).

According to Czikszentmihalyi (1996, 6) creativity results from the interaction of a system composed of three elements: a culture that contains symbolic rules, a person who brings novelty into the symbolic domain, and a field of experts who recognize and validate the innovation. All three are necessary for a creative idea, product or discovery to take place. Gardner (2006) identifies four levels in creativity: sub-personal level, which is made up of genes and the structure of nerves, individual level (i.e. intellectual ability), extra-personal level, which refers to the factors outside the person, and multi- personal level (i.e. context linkages which may limit creativity).

Creativity (Czikszentmihalyi, 1996, 8–9) is a process by which a symbolic domain in the culture is changed. Because these changes do not happen automatically, we must consider the price we must pay for creativity. It takes effort to change traditions, i.e. memes (units of information that we must learn if culture is to continue). A musician must learn the musical tradition, the notation system, the way instruments are played before s/he can think of writing a new song. Consequently, if we want to learn anything, we must pay attention to the information to be learned (see Figures 1 and 2). And attention is a limited resource.

As cultures evolve, it follows that specialized knowledge will be favored over generalized knowledge. Cropley & Cropley (2009; also Cropley, 2015) specifies that this trend toward specialization can easily lead to a cultural fragmentation. Also, creativity generally involves crossing the boundaries of domains. Creative individuals, on one hand, are often considered odd and even arrogant, but on the other hand the traits are attributed to them on the basis of our perceptions. It is the demands of their role that push them towards specialization.

The purpose of using 635 in this study was to enable the participants in continuing HE to explain their conceptions of change management at their levels of competence. Earlier they had solved professional problems connected to their work using the 7-step method and deepened their professional knowledge through it. At skills level they were expected to develop and apply techniques and tools for change management in a new way. A hoped for outcome was that they would develop their competences to create new perspectives (c.f. Brockman, 2010). As 635 is one of the creative problem solving methods which can be used in teams, it appeared to be suitable for meeting professional challenges that demanded totally new solutions.

Creativity, creative problem solving and decision support contribute for instance to leading and project management. Especially, in the contexts of advanced methods, 635 is strongly linked to decision support. In these situations there are usually many options, but at the end one is chosen (Brockman & Dirkx, 2006).

RESEARCH METHOD, DATA COLLECTION AND ANALYSES

The processes took place in the University of Applied Sciences (UAS), in the School of Vocational Teacher Education. Music students (N = 62) from ages 17–24 represented the local music conservatory education program in 2003–2011, and the business engineers (N = 6), with academic degrees, were the leaders of an international firm on three continents. They came from several European countries, the USA, China and its neighboring countries and participated in the "training for trainers" –course in teachers 'continuing education department of Oulu UAS between August and December 2013. The PBL 7-step and 635 processes were strictly documented. The documents consisted of written outcomes of the practices, interviews and observation notes. In 635 there was also a key of pseudonyms.

The research questions were:

1. What does the 7-step PBL method reveal about music students' learning?
2. How do international business engineers process the problems by the creative method of 635?
3. What similarities and differences can be observed in two different professional groups and their problem solving processes?

The research paradigm follows that of case studies (Yin, 2009). The results were analyzed with qualitative contents analysis (Berg & Lune, 2012; Schreier, 2012). The data sources were complementary and yielded detailed experiential information vocalized by the participants. Each relevant passage was read and statements were isolated which captured the meaning expressed by the participant. Thematic patterns were developed, individual conceptions of the

experiences were given attention to and the descriptions were arranged to give meanings to the themes.

The trustworthiness was developed through multiple sources and two researchers who interpreted the respondents' statements together. Through prolonged engagement with the participants and the incorporation of member checks in the seven-step method, the truth value was sought to be established (Moschovich & Brenner, 2000; Patton, 1990).

The Method – in details
The realizations of PBL took place in the research groups in the ways described below. The processes were not identical, but the aim of adopting/ adapting PBL was the desire to make the processes systematic and analyzable.

In *music education* research, 11 pop and jazz music workshops were organized according to the PBL seven steps method. The throughput principle was to take professional musicians along to the work context, to practice and perform with the students. The workshops (Fig. 2) were started with joint planning and goal setting in which the music theme and challenges in respect with the students' skills were discussed. After choosing the theme further tasks and preparation work were agreed on. The students defined their personal developmental tasks in the workshop and wrote them in structured target forms.

The next phases were periods of music exercises in which the students worked on the workshop material independently supervised by their own instrumental teachers and as an ensemble under the supervision of the teacher in charge of the workshop. Independent exercises were daily, and ensemble exercises 2 or 3 times a week. The intensive period after the workshop was carried out so that the professional musician came on Monday and started practicing with the students. Typically the days were 6–7 hours. At the end of the week they had a performance which was followed by cooperative evaluation through discussion. Personal workshop feedbacks were written down and assessed in respect to the set goals (cf. Nuutila et al. 2005, p. 126).
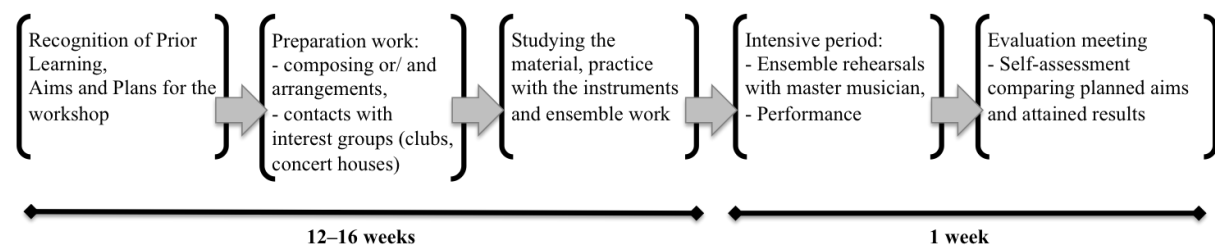

Figure 2: The steps of progress in the workshops (see Virkkula, 2015).

The research material concerning music students was collected in two phases. At the beginning of workshop work *(phase 1)* the students (N = 62) wrote structured workshop plans

setting their learning goals. The plan proceeded according to the questions: "How did you participate in preparing the workshop?", Describe the theme of the workshop, for instance the style of music?", "How do you intend to prepare yourself to the workshop?" "What do you want to learn in workshop work?" "What other expectations do you have concerning workshop work, working with a professional musician, workshop concert?"

After the workshop *(phase 2)* the students (N = 62) reflected on their experiences of the workshop and answered the following open questions: "Describe cooperation with a professional musician?", "What did you learn in the workshop?", "What could you have done in another way?"

Among *engineers* some basic characteristics of creative problem solving were discussed first and the usage of the method explained. It was remarked that there was a distinction between creativity and innovation. Creativity is the generation of novel and useful ideas, while innovation is a deliberate implementation of ideas. It makes money or value out of creativity. Innovation is more than invention. It is the specific function of entrepreneurship, the means by which the entrepreneur either creates new wealth-producing resources or endows existing resources with enhanced potential for creating wealth (see Drucker, 1985).

The engineering enterprise connected to the present study was analyzed from several points of view. The multicultural continent leaders who were engaged in this study were willing and able to use also the seven steps –method. It was noticed that in their enterprise there is a rather low hierarchy, the culture is risk-taking, work design is team work, management/ leadership supports the ideas if introduced well and made understood, and networks and collaboration with universities, suppliers and competitors are well taken care of (cf. Kanter, 1983). The enterprise tries to balance technology with customer service.

The way of applying the 635 method in this presentation was the following. First the rules of brainstorming/ brain-writing were explained. 635 stood here for 6 participants, 3 problems and 5 changes of papers during one "round". The time allowed to each participant started from two minutes and increased to five when the work proceeded.

 After defining the problems together the "owners" of the problems, one owner per problem, were nominated. No owner was allowed to suggest solutions to his/ her problem, since s/he was to choose the best solution to his/ her problem at the end.   The problems were written on sheets of paper, one problem on one sheet. Everyone in the group read one problem at a time, wrote his/her suggestion on the paper and signed the suggestion with a pseudonym, moving the paper to the next person.

The session ended when the participants had worked on three problems during three rounds. In the last phase called "objective criticism" the ideas were to be examined. The owners of the

problems suggested the best solutions giving their reasons for them. The solutions were talked about and evaluated together.

The participants of 635 may experience creative stress: they have to come up with great many ideas while working against the clock. It can spur to mental productivity or in some cases inhibition. Especially important it is to understand that the PBL process is not only a mental game but can be continued in real-life contexts dealing with similar kind of practical problems as in the exercise. 635 is also an example of productive team work.

The engineers produced research material during the session. After the session they gave oral or / and written evaluation and reflected on their experience. The comments were written down and used for explaining the data obtained.

The data from both *music students and engineers* were transcribed and tabulated into categories which represented the characteristics of problem based learning (Schreier, 2012, p. 2–5; also Krippendorff, 2004; Marshall & Rossman, 2011; Miles & Huberman, 1994). The categories of music students were: 1) motivating the learners, 2) goal-oriented working both communally and individually, 3) contents of learning, and 4) role of a supervisor. Tabulation made it possible to examine the material widely from the viewpoints of students, workshops and categories. The engineers' material was categorized first into the classes of structure, technology and people according to the main contents and then, after a closer analysis, into 1) goal and planning, 2) cooperation, 3) skills and competences and 4) people concerned. Thus the categories of both music students' and engineers' research material are very much alike.

OUTCOMES

First the outcomes of the 7-step method among music students are reported, next those of the 635 are described. Then the results will be examined as one set of data according to the core contents of both outcomes.

Music education
The starting point of music education is to prepare a student to meet the challenges of his/ her future work and find relevant solutions to them. The studies must include elements that direct the student to solving professional problems autonomously and cooperatively (cf. Savery, 2006, p. 13).

The research showed that preparing a concert or a gig program in a workshop was a seven-step problem solving process in authentic work situations for students. They met the problems with visiting professionals and learnt to solve them by seeking for knowledge, analyzing, evaluating and applying it to practice. Table 1 describes how the workshop work appeared in respect to the seven step model and to the categories of results (motivating students, goal-

oriented work both individually and cooperatively, contents of learning and role of a supervisor).

Table 1. The seven steps of PBL in the workshops of music students.

	The seven steps model of PBL (Schmidt, 1983; Savin-Baden, 2007; also Savery, 2006; Wolff, 2000).	**PBL in workshops**
Step 1	Setting the problem	The theme of the workshop is reflected on cooperatively (teacher, students, professional musician)
Step 2	Defining the problem	Delimiting the chosen theme of workshop together
Step 3	Analysing and clarifying the task	Analyzing the contents of the workshop theme, e.g. the challenges of learning in respect to the skills of students (Recognition of prior learning) ⇨ Analyzing the student's skills (teacher and student) ⇨ Completing the skills before the workshop
Step 4	Suggestions for the solution are gathered and compared and the alternative solutions are gathered	Decision of the workshop theme, choice of music, the choice of location
Step 5	Individual and collective goals and tasks are decided about	Division of the tasks, preparation work, setting the learning goals: ⇨ Planning and goals - Written goals of the workshop *(the 1st part of the research material)*
Step 6	The implementation of the tasks individually or collectively	Instrumental and ensemble exercises, connections to interest groups, informing and marketing, performance.
Step 7	Reporting and evaluation of the results in the discussions of the participants	The cooperative examination of the workshop work's outcomes in relation to goals, as well as the reflection of individual attainments and experiences literally. *(The 2nd part of the research material)*

In the seven step -method the first steps (1–5) had a great importance on the learning outcomes. Defining the problem, analyzing it and the aims set for working had influence on motivating *(data category 1)* and connecting the students to the joint project. The student statements after the first five steps describe the awakening of interest towards the workshop and exercising playing, which also refers to taking responsibility on their own learning (cf. Savery, 2006, p. 12–13).

> "Of course I want to learn new pieces, but also ideas of how to realize them with the band. I also want to measure my skills and see if I am able to work with a professional musician. (…) I hope that I will get a lot of new ideas of my own during the workshop." (A35)

Problem-based learning is goal-oriented; for that reason it must have defined goals (e.g. De Graaff & Kolmos, 2007, p. 7). Students found the performance connected to the workshop an important part of working for two reasons: it motivated them to practise their own part carefully and acted as a spur to do their best *(data category 2)*.

> "In a concert everyone wants to give his/ her best; so s/he has to work for attaining it." (A3)

"Concert is a good culmination for the workshop and it also gives punch to rehearse." (B22)

From the viewpoint of developing musicianship (PBL step 6) workshops were connected to the development of the student's musical skills, self-motivation, and activity and in general to the core skills of lifelong learning *(data category 3)*. Preparing for a performance appeared to be a problem solving process which required the student to take responsibility and initiative. Goal-oriented striving through individual instrumental exercises and communal ensemble work seemed to guide students to notice the importance of engagement in the work of a musician.

"(The workshop) told a lot about a musician's everyday life, and the practical experience taught how fast a performance repertoire can be put together, what pre-preparations must be done." (A60)

"When my own parts are well under control before the ensemble practice, everything is easier. The artistry in music can be brought out." (A55)

Students' statements reveal how problem-based work influenced on understanding the role of contents in a musician's work, for instance how to act to get relevant outcomes. Cooperative dealing with the experiences and writing the feedback (PBL step 7) immediately after the performance organized the students' view on the musician's work.

"In the beginning I was dubious of my ability to perform the large vocal ranges and also the stylistically different songs. Still I went through the challenges to victory, and it felt really fine. I learnt again to believe in my abilities throughout the workshop and in fact that concentration and practice ensured the successful result." (A23)

The role of a professional musician proved to be significant in the learning process, but different from the tradition *(data category 4)*. He was maybe expected advice and control of learning, but along the time the students became more active and asked and explained things autonomously. The musician's task in relation to students seemed to be an encouraging supervisor, the facilitator of learning and a partner.

"The (workshop's) atmosphere was really relaxed, which helped working and the adoption of tunes. The pieces were really jamming / improvisation based, so we used a lot of time to find the right mood and the same wavelength." (A43)

"The professional musician did not give so much feedback as I had hoped for, but on the other hand he confirmed in that way that the students became active to listen to themselves." (A49)

The students' skills were challenged widely. Skillful working was based on planning the items to be learnt. Action models were expected to become internalized with the help of reflection of learning experiences. In acquiring professional action and skills in music communities, social interaction and cognitive processing were observed to be important (cf. Dolmans et al., 2005, p. 732–733).

Acquiring learning experiences in the duties of a musician had influence on the development of the students' musical skills and problem solving abilities. Workshops directed the students towards responsible and initiative working, creating joint spirit and critical evaluation of oneself and the group.

Multicultural engineers

The blocks of the participants in the 635 method were removed by trying to strengthen their self-belief and individuality, by accepting mistakes and imperfection in their experiences, suggesting them to have fun and positive attitudes and accept criticism as an item of learning. The rules of brainstorming were also repeated. In the planning session the managers talked about the problems that would be waiting for them in a few weeks' time because of Christmas holidays and the need of support from the side of customers. They decided to concentrate on solving acute real-life problems connected to travelling and full-time on-call of their service departments.

The problems to be solved were:
1) The suitcase has not arrived with the passenger. It contains important material for training. What can you do?
2) Holiday time is coming. How do you take care of customer service support during the holidays?
3) An important service person is going to leave the organization. How can he be made to change his mind and become motivated to stay in the organization?

The suggestions (N = 33) were mainly realizable. A common idea in the first problem was to ask the imagined audience to tell their expectations and then proceed in training according to their expectations and use situational sensitiveness. How to do this varied according to the persons. Typical suggestions were:
"Try to be creative at the training."
 "Act according to the situation."
 "Make the training more interactive."
 "Try to fill the training as much as possible with Q's and A's (questions and answers)."

In question number 2 the suggestions went further apart including monetary solutions:
- ample financial compensations to engineers, and
- demanding extra payments from customers.

Also suggestions were made to arranging
- phone service from the holiday resorts,
- varying days-off during Christmas,
- a back-up machine provision for customers during holidays,
- help from partner companies on "scratch my back and I will scratch your back" – principle.

Suggestions to problem number 3 were the most imaginative: all contained some golden grains. Examples of suggestions were:
- making a needs assessment study of the person in question
- offering more money and higher position
- telling that the grass is not greener on the other side of the fence
- researching the weaknesses of the other company.

Many suggestions pointed at making the person in question feel empowered through various, even imaginative arrangements at work. The next quotation comes from the most realistic ones:

"Study his interests; offer him interesting tasks and new challenges, also a better future image and personal development".

To evaluate the produced ideas the following questions concerning all suggestions were presented, especially about the problem owners' choices:
1. Why is the chosen solution the most promising?
2. Which realities prevent the solutions possibly from coming true?
3. What kind of breakthroughs would be needed to realize the solutions?
4. Could the idea be developed on in this session?

The exercise with 635 was the first that the participants had ever met in creative problem solving. It caused a certain kind of restraint in the suggestions. In general their action was not pure brainstorming, as they gave a lot of attention to practical implementations. There are limits to what a manager can change, and the participants stayed mainly inside the limits. Their ideas fell into three categories:

1. *Structure* which concerned mainly job redesign, chain of command and work specialization (problems 3 and 2).

2.   *Technology* concerning work processes, methods and equipment. This was the greatest concern of the participants understandably, since it was their main specialist area (especially problem 2).
3.   *People* who caused the concern of concentrating on finding out attitudes, expectations and behavior (problems 1, 2 and 3).

Although the present PBL exercise didn't bring out anything completely new or any revolutionary services or processes with higher uncertainty or risk, it opened a new way to solving everyday problems which can later be developed and made better especially in the enterprise concerned. The value of the present method of 635 lies in its future applications.

The outcomes compared

Having a look at the outcomes of both musicians and engineers does not bring too many similarities at first sight (see Table 2). A deep analysis provides differences and similarities in thinking and attitudes. They are evaluated from the perspectives of goal-orientation, planning, skills, competence, people and collaboration.

Table 2. Comparison of the music students' and engineers' results.

	Music students in Conservatory	**Multicultural business leaders in engineering**
1) How were the goals defined?	- General goals were defined through collective reflection, personal aims based on recognition of prior learning were defined individually.	- The shared goal was tied to the business enterprise and its success. Individual goals were parallel, but varied because of the situations in different continents and the everyday needs of each respondent to solve practical problems.
2) How was the action planned?	- The problems were defined first and then the action was planned to be in harmony with the aims and means.	- The problems were defined through collective dialogue (see Senge, 1990), first introducing a lot of possible problems facing the enterprise and then limiting them to three most obvious and acute ones.
3) What skills became apparent either in action or in goal setting?	- The music students analyzed the contents of the workshop theme and the challenges in respect to their skills. The students made plans how to complete the skills before the workshop's intensive period.	- Engineers technical skills were up-to-date, but their human relations skills were defective and they were not able to motivate and supervise their workers sufficiently. This was the greatest difference between the groups: music students needed especially practicing their technical and instrumental skills, the engineers their human relations skills.
4) What competences appeared significant in the process?	- Besides instrumental skills the students had to decide about the theme, choice of music and set their learning goals. They included more than technical performances: to understand the music to be played and find the ways of expression.	- Engineers talked about motivating the staff before they started the PBL task. The technical competence was seen the most important, but gradually they noticed that it is the staff motivation that makes the profit. During the PBL task they tried to settle in an employee's position. The difference appeared again between the technical and mental proficiencies.
5) What aspects or human characteristics were considered?	- The Music students were greatly motivated by the 7-step method workshop. They felt that the process proceeded in the way that is also met in musicians´ everyday life. Another motivator was the professional musician and the cooperation with him/ her. The possibility to build the whole process from the first planning to implementation and evaluation was not only inspiring but also very instructive.	- The understanding of human characteristics of the staff was relatively scant among engineers. It may possibly depend on their restricted vocabulary (they didn't speak their mother tongue) and the lack of familiarity when talking about people's attitudes and expectations. They moved outside their comfort zones and could not express that which they possibly indirectly understood. This difference between the students and engineers is in connection to the two earlier ones.
6) What role was given to collaboration?	- The Music students praised cooperation in ensemble exercises, connections to interest groups,	- Engineers trusted on collaboration in all that they did in their work. While professionals in music are both individualistic

collaboration with fellow students, teachers and professionals, which all spurred them to reach individual goals. Thus the workshop served both collective and individual learning.

and team persons, engineer are first team workers and, secondly, individuals. They must have individual competence and knowledge first, but they share the aims in the team and they have to master team work. They have also to understand systemic organization to be able to act as continent leaders in an international business enterprise. This difference follows from the characteristics of the jobs of a musician and leading engineer.

In both cases processes were based on planning and stating the aims and goals partly by joint planning and reflection, partly by individual reflection and recognition of skills. PBL emphasizes the constructive nature of the process, which means that in the starting phase it is important to make a careful charting of competences and planning of action (e.g. Nowrouzian & Farewell, 2013). In this study, through the above mentioned policies, efforts were made to ensure the active participation of the research persons from the very beginning of the process.

The problem connected to the process was exemplified, and the action models to solve it were dealt with and accepted cooperatively. This kind of expert dialogue led to the demonstration of the problems as work processes. Both musicians and engineers had to take stand to technical and contents matters, evaluate their skills in them and learn new concepts. The problem stimulated learning, when the participants had to make choices and efforts towards the aims they had defined (e.g. Dolmans et al., 2005).

Learning took place in the real world contexts dealing with and solving authentic problems (e.g. Savery, 2006; also Dolmans et al. 2005). The experience illustrated the problem solution process at practical level, which helped the learners to develop themselves towards autonomy.

The outcomes reveal how important it is to reflect on the gained results cooperatively and individually. In collective dialogues the shared understanding of the group was constructed concerning both the contents and learning processes (cf. Nonaka & Takeuchi, 1995). In individual reflection the respondents assessed their levels of present competence and their future expectations. In the future, learning processes will be based on earlier, through reflection recognized experiences (cf. Kolb, 1984). Problem-based learning processes will help the learner adopt critical reflection as part of his/ her working method and general professional practices. This is how s/he promotes the development of his/ her competence according to the principles of lifelong learning (e.g. Dreyfus & Dreyfus, 1986).

CONCLUDING REMARKS

The results show that not only were the learning targets of music students reached but, with reflection included, every step of the process widened their professional competences remarkably. In the group of engineering business leaders the 635-method raised them to give attention to human-centric viewpoints in problematic situations. The methods appeared complementary: creativity was needed in the 7-step method and organized knowledge of the basic factors was necessary in the 635.

When comparing the results of these two experiments, there are more similarities than differences. The supposition was that there should be differences between music students and business engineers in creativity and/ or rationality. Instead, both groups could act systematically and creatively. Music students concentrated on deeply professional issues and the skills needed in performing music and marketing it both rationally and creatively. Engineers opened the gates to human-centric ways of thinking and seeing the world when they tried to create personally satisfactory ways of solving practical problems.

Earlier in musicians' education the projects resembling workshop work emphasized the attainment of a concrete purpose (to realize a performance, to make a product etc.). In them reflecting on learning usually received less attention (e.g. Savery, 2006, p. 16). Reflection has, however, an essential role as part of goal-oriented PBL learning as well as the 635 method. The starting points of action, process, contents (e.g. the solutions and conceptions) are evaluated critically, which promotes the construction of shared understanding, learning from others and questioning everyday beliefs and issues taken for granted (see Mezirow, 2009). Critical evaluation serves cognitive reasoning. Individual and collective reflection are utilized both in the 7-step and 635 –methods (cf. Wenger, 2009, p. 210–211; Jarvis, 2009, p. 25; Senge, 1990).

A freely constructed PBL-method (7-steps) appears functional, applicable and recommendable in higher education (e.g. Savin-Baden, 2000). Enthusiasm and positive atmosphere are highly important factors in real life, leading to collective responsibility and caretaking. The support of learning communities and individuals' willingness in professional growth are the prerequisites of empowerment (e.g. Arneson & Ekberg, 2005). In creative problem solving (635) cognitive reasoning is put aside at first and the hidden powers of mind are let free. Accumulation of knowledge and incubation come out as ideas which are evaluated and then possibly implemented. Letting one's mental powers free may lead to unusual associations between ideas. They are needed in everyday life of individuals and communities (see Kietzmann et al., 2013).

The key to successful implementation of PBL lies in designing a learning environment that stimulates students towards constructive, self-directed, collaborative and contextual learning and in consistency in or alignment between all aspects of the curriculum, such as the problems used, the tutors' guidance and the assessment employed (see Savin-Baden, 2000). Problem-based learning will raise the level of learning in higher education by introducing a systematic way of approaching problems through the seven steps method and trying to encourage academic people to let their creativity loose towards creative brain-writing and innovation. Lateral thinking promotes creativity in its ability to make connections. The success of an organization is determined by the quality of new ideas, since the competitive edge comes from creative thinking. Equally important is to understand that knowledge grows from cognitive commitment and exchange with others. It will lead to transformation.

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