Integrating transferable skills in teaching at Aalto University

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Foreword

First, there was an open question what is good teaching.

The current study was initiated in Sannäs in January 2014 as a research task related to the pedagogical course Teacher as a developer (Opettaja kehittäjänä). In the course, the research approach was taken as a tool to study and to further develop the concept of good teaching in different levels at Aalto University. Our team of seven teachers, MetaFlow, worked the whole year 2014 with an attempt to define, in which ways transferable working life skills are currently integrated and how they should be integrated in teaching at Aalto University. The name of our group, MetaFlow, origins from the empowering feeling, flow, in our bi-weekly meetings on the working title “teaching meta-skills".

The topic turned out to be highly interesting and having impact for Aalto University. This study is intended for anyone interested in teaching or learning transferable skills at universities. Our focus has been on the teachers and the teaching.

This study would have not succeeded without meetings of experts of transferable skills. They provided new insights in our thinking. So, our team wants to thank all those who gave their time for our interviews. We hope that the expert network will be available for teachers and educational leaders in the future.

Finally, we feel privileged that we have been able to take part in this pedagogical training at Aalto University. The journey with contact sessions, exercises, self-reflections and discussions has beenan inspiring experience. Most of all, we want to thank our supervisors, Jenni Koponen and Maire Syrjäkari, for all the encouragement and support during the project and training.

An open question means that there is no final answer. We hope that we have brought new insights to what good teaching in the area of transferable skills can be.

Espoo, 16.12.2014

The MetaFlow alias

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1. The need of integrating transferable skills to teaching

The teaching tradition at universities focuses greatly on the transfer of content specific information. However, today the demand from working life includes more and more transferable skills, such as team working and communication skills as well as the ability to define one's own goals and make ethical decisions. The dilemma then centres on how these skills can be incorporated into the curriculum. As teachers at Aalto University, we are interested in developing teaching excellence by analysing how the integration should be achieved.

Thus the topic of our study is directed at "Integrating transferable skills in teaching at Aalto University". This title can be separated into three items, "transferable skills", "integrating them in teaching", and "Aalto University". First, the transferable skills are those sorts of skills which education is supposed to deliver in any discipline and which can be applied in different contexts. From the literature, the term transferable skills has been labelled with a host of different names, such as key skills, working life skills, or generic skills.

Second, we propose that transferable skills should be integrated into content teaching. The support for this comes from the fact that skills tend to be used in certain contexts. It should be noted that allotting time for the teaching of a skill in a content course may decrease time for the actual content. However, most transferable skills provide tools for deeper student learning, and in this way they can make teaching more effective.

Third, all the authors of this study come from Aalto University which is the primary location of our experiences. The group consists of seven teachers from the Aalto Schools of Business, Electrical Engineering, Engineering, and Science. Moreover, we are confident that teachers in other fields will find our work invaluable and will be able to readily apply and adjust the results and the recommendations to their own discipline.

This study consists of an introduction, seven essays, and a conclusion with recommendations, (Fig. 1). The seven skills thematically addressed here are self-knowledge, reflective learning, critical thinking, creativity, teamwork, negotiation, and sustainable development. These essays can be read independently, but represent different supporting arguments for the paper's conclusions. The final concluding chapter provides a synthesis that was derived based on the findings in the seven themes. Furthermore, recommendations are provided for educational leaders, teachers, pedagogical units, and students.

In the remainder of this introduction, we will explore the motivation for this study and define our research questions for the work. Similarly, there are short descriptions of the seven themes of transferable skills which are then covered in detail in chapters 2–8.

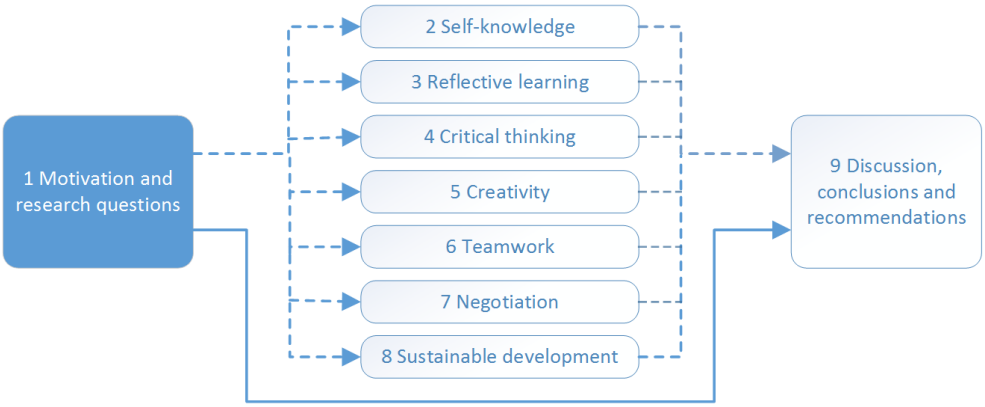

Figure 1. Chapters of the study. The seven essays, chapters 2–8, can be read independently.

1.1 The need of transferable skills in higher education

Education, at any level, provides cumulative development in a student's knowledge, skills, and attitude. In this study, we focus on teaching transferable skills at universities. From our experience, we feel that transferable skills are not taught as effectively or profoundly as they should be. These skills are not only important in the working life, but they may enable student learning that is much more efficient and deeper in the quality.

Related to the skills, a continual evaluation is conducted between the skills of the graduated students and how well they match the needs of working life. To this end, Aalto University, Tekniikan Akateemiset (TEK), and Suomen Ekonomiliitto (SEFE) conduct yearly evaluations of graduated students who are starting their professional career. The survey by TEK in 2013 included experiences of the studies by 1307 graduates in Finland, and a summary plot is given in Fig. 2. One can argue from this data that there are certain gaps between the studies and the actual needs in the work life. The solid pink and brown lines depict how a certain skill has developed in studies at a university and in the work life during the studies, respectively. The dashed line is the expected importance in the work life. The seven skills with red ovals around them—ethics and sustainable development (11), negotiation (14), teamwork (16), self-knowledge (18), creativity (19), critical thinking (20), and reflective and life-long learning (22)—are covered in more detail in this study. The student evaluations cannot be the only guide for the definition of the degree requirements. However, the signals from other sources are relatively similar.

According to its mandate, one primary role of the university should be to influence the working life via its research and education. Here, the strategy of the university sets the promise for the society on what kind of assets its education

will support. Aalto University promises to work towards a better world and to promote values: passion for exploration, freedom to be creative and critical, courage to influence and excel, responsibility to accept, care and inspire, integrity, openness and equality. Moreover, the strategy sets a goal to integrate sustainable development in all teaching.

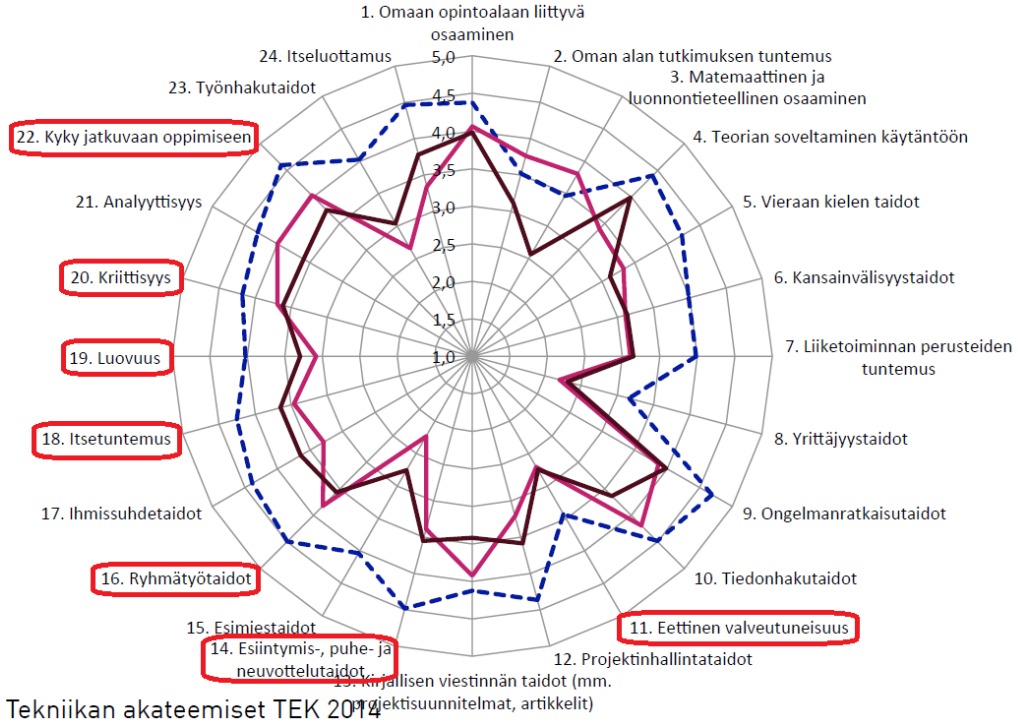

Figure 2. TEK evaluation on the skills of the engineer graduates, N=1307, in Finland (Tekniikan alan vastavalmistuneiden palautekysely 2014). Skills with red ovals are discussed in the essays. Dashed line: Importance in the work (1 = not at all important, 5 = very important). Pink line: Development in studies (1 = very little, 5 = very much). Brown line: Development in the work life during the studies (1 = very little, 5 = very much).

1.2 Research questions, methods and approaches

This study asserts that transferable skills are an important aspect of quality teaching at a university. Excellent teaching should result in the students developing a deep learning in substance, skills, and attitudes. Hence, we set the following two research questions for our study:

1. What is the current situation for the teaching of transferable skills at Aalto University?
2. How can transferable skills be integrated into content teaching at Aalto University?

For the first research question, we created an overview by collecting a set of transferable skills from different sources. The CDIO Syllabus (Crawley et al. 2010) provided one source which was a useful anchor in this regard. Furthermore, we conducted some keyword queries into the curricula information at

Aalto University. From this, we identified potential courses for each skill by reading the course titles, contents, and learning outcomes of the courses. Finally, we compiled a list of experienced teachers for whom to contact.

The approach to tackle the second research question was through a literature review and expert interviews. Both research questions were similarly explored through the paradigm of the chosen seven skills. These were chosen mostly according to the interest of each team member. These were studied first independently and then the findings were discussed together. The work with seven skills provided insights into how transferable skills, in general, should be integrated into teaching. Based on the discussion, we derived the conclusions and recommendations.

Our approach was pragmatic and not so strict from a scientific perspective. To this extent, it may be stated that whatever knowledge we aim for in teaching, we also include the teaching of certain skills even though it may be unintentional. Teachers may also believe that students learn these skills just by doing without explicitly teaching them. Hence, the question is not whether to include transferable skills learning in our courses, but which skills should be integrated in our teaching and how to teach them effectively.

1.3 Introducing the selected themes

Our team selected seven skill areas to focus on: self-knowledge, reflective learning, critical thinking, creativity, teamwork, negotiation, and sustainable development. These were chosen primarily by the personal interests of each member, but also based on the Aalto University strategy and the observed gaps found in the skills of the graduates. Our assumption was that after analysing several different skills independently, we can find common principles for integrating any transferable skill to teaching. Next, we introduce the selected skills which are discussed in detail in chapters 2–8.

Self-knowledge (Chapter 2): Knowledge about oneself is necessary for learning and development. Self-knowledge matures through experience, reflection and introspection. Self-knowledge development is a life-long process, and a learning environment that offers quality feedback channels can facilitate self-knowledge development.

Reflective learning (Chapter 3): Essential learning skills are an important asset when students move on to working life, which in turn calls for lifelong learning and professional development. At the core of these learning skills, reflective learning implies the learner is actively engaged in the process of identifying a problem or an experience, deliberately deciding to solve or examine it, collecting related information, achieving the outcome of changed thinking, and acting on this new understanding.

Critical thinking (Chapter 4): Critical thinking involves open-minded yet logical and objective evaluation and analysis of evidence, while remaining mindful of various assumptions, biases, and subjective effects, including the possibility of committing logical fallacies and other "errors" in thinking. It plays an important role in achieving the student-centered learning culture envisioned by Aalto University. Yet graduating students currently feel that they are not provided with sufficient critical thinking skills during their studies.

Creativity (Chapter 5): Creativity is mentioned among the key components in many societal contexts, especially due to its close link to innovations. In the Aalto University strategy, creativity is strongly emphasized. Creativity or products of creative work have been defined in various research studies through three main components—originality, quality, and usefulness. Similarly, innovation can be defined as a product of creative work that has economic value.

Teamwork (Chapter 6): Group assignments and project works are quite often utilized in Aalto University courses, but do teachers actually support the learning of the teamwork skills needed in working life? Successfully working in a team demands various interpersonal and intrapersonal skills. From the viewpoint of a teacher, an effective teamwork implementation requires the creation of positive interdependence inside the team.

Negotiation (Chapter 7): One of the shortcomings of the current curricula at Aalto University seems to be the lack of negotiation training. Yet, the ability to negotiate and to find a common ground is vital as individuals, companies and other organizations do not operate in isolation, but work with, and are dependent on each other. Hence, negotiation, defined as a form of decision making in which two or more parties attempt to resolve their opposing interests, lies at the core of organizational and individual cooperation.

Sustainable development (Chapter 8): The drive towards sustainable development is commonly accepted as a major paradigm today. Sustainable development is defined as a development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Aalto University strategy states as one of the goals to integrate sustainability and responsibility into all teaching and research by 2015. Here, the interdisciplinarity of Aalto University offers an exceptional opportunity to become the leading example among those universities aiming to integrate sustainable development into their curricula.

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2. Gaining self-knowledge through studies

Eerikki Mäki

This chapter has three aims. First, it introduces the concept of self-knowledge. Second, it tries to convince the reader why self-knowledge and ability to improve one's self-knowledge are significant. Third, it evaluates how university as an educational platform can support the development of students' self-knowledge.

University and its teachers must recognize and understand that their role includes a heavy load of demands and responsibilities. Teachers have huge impact on individual students and what kind of citizens they become. One interviewed expert was perfectly aware of his crucial role when emphasizing that students need to feel safe and trustful when working with such a delicate instrument as themselves:

> "Improving self-knowledge through reflection does not mean working in the discomfort zone, but rather discovering how large own comfort zone can be"[1].

Human beings are curious by nature. They seek information in order to create understanding on their environment, but also on themselves. This generates *self-knowledge* and mental models that help operating in the world and accomplishing adequate behavior. Self-knowledge has already been identified as one key feature of effective learning (Wiezbicki-Stevens 2009) and this chapter further discusses and evaluates the importance of self-knowledge on students' learning and development. Self-knowledge is important in a learning process because it e.g. enables students to expand their awareness on what they know and what they don't know, and be goal oriented in their learning efforts. Self-knowledge also helps students to choose appropriate learning methods for themselves (Pinthrich 2002).

Self-knowledge is a vague concept and its meaning to different people can be unalike. In this chapter self-knowledge is understood as *knowledge or understanding of one's own capabilities, character, feelings, or motivations*[2]. It should not be confused with e.g. self-esteem or self-confidence even though these concepts can be somewhat overlapping. With self-knowledge Aalto University students (and other people as well) can answer the question *What am I*

1 It is often stated that individuals do not develop or learn if they are not willing to exit their comfort zone. Here the interviewed expert does not agree with this statement, but rather takes th opposite approach.

2 http://www.merriam-webster.com/dictionary/self-knowledge

like? From a philosophical perspective this is one of the most essential questions, but it has huge practical importance and implications as well. This question helps evaluating our strengths and weaknesses, understanding what interests, attracts and motivates us, and directing our attention and efforts. Better self-knowledge can help students to become more self-directed (Garrison 1997) or self-regulated (Zimmerman 1990) in their learning journey. In reality great deal of autonomy and self-sufficiency is usually expected from the university students.

Self-knowledge is difficult to operationalise, which is one reason why self-knowledge and its development is challenging to specifically include into learning expectations or outcomes of a university curriculum. Students might even have diverse goals regarding their self-knowledge development needs or desires. This is justifiable because students are different and they have different needs. Additionally, university teachers cannot (or should not) control or measure everything that students learn. Sometimes – if not often – students' learning outcomes even remain more or less invisible to the teachers. Development of self-knowledge is one excellent example of this kind of learning, which is often difficult and sometimes even unnecessary to measure by teachers. Nevertheless, self-knowledge and its development is one important element that directs students when they are progressing in their studies and preparing themselves into working life after graduation. Therefore at least students should pay attention on how their self-knowledge develops during their studies.

University education has a long tradition of teaching facts, even though for students it might be sometimes much more beneficial to develop general types of intellectual capabilities and learning strategies. Besides factual knowledge, university education should aim at developing students' skills in a way that help them at evaluating and utilizing their full cognitive potential and increase that potential. Students should become active processors of information instead of being passive targets of poured "wisdom of professors". This can be achieved through better self-knowledge that can help students at deploying and directing cognitive resources, and learning. This may also require more tolerance and flexibility from the teaching staff because at a metaphorical level their role may change from a pilot to a tourist guide. Anyhow, in university education the emphasis should be in learning instead of teaching (Lujan & DiCarlo 2006).

Based on large empirical studies Lutham et al. (2007) propose that positive psychological capital and its components (efficacy, optimism, hope, and resilience) have huge effect on performance and satisfaction of people. We can assume that self-knowledge gives people vital information regarding their own positive psychological capital. We can further assume that methods that help evaluating and building self-knowledge are beneficial for Aalto University students. Moreover, the ability to self-evaluate one's own cognitive, technical, and transferable skills and their development becomes more and more important when studies advance. Sometimes the sources of external feedback are very limited and internal perspectives must be applied. Dominating one's own profes-

sion (both during the studies and after the graduation) requires that an individual is able assess one's own performance. Good and reliable self-knowledge is beneficial – if not crucial – in this.

2.1 The role of feedback in gaining self-knowledge

Accurate and reliable feedback is fundamental in a learning process. In order to be successful in anything, a human being must have knowledge of herself and her performance. Feedback is an essential element in recognizing, evaluating, and developing one's self-knowledge. Most commonly feedback during university studies is associated with the development of e.g. technical skills or cognitive capabilities, but the feedback can also be connected with e.g. student's philosophy of life, personal character, feelings, or motivation. All of these elements are important in building one's own self-knowledge.

Regarding their learning and development, Aalto University students get feedback from various sources. There are three main sources or channels of feedback in learning that help gaining self-knowledge:

1. Feedback from teachers
2. Feedback from peers
3. Feedback from introspection

Feedback from teachers is usually given in the form of grade, but may include written and verbal comments on student's learning and learning needs as well. A plain grade number of a course or an assignment does not necessarily tell very clearly what a student did learn, and what he did not learn that well. Teachers' comments improve the quality of feedback remarkably. With verbal or written feedback a teacher can address in more precise ways how a student has achieved the learning objectives. In many courses (i.e. Bachelor level courses having hundreds of students) that kind of feedback is difficult to give because of the large number of students. In some courses or assignments students may get feedback from e.g. instructors from industry. They can be considered as teachers as well (even though they are not employed by the university). This kind of feedback has strong practical relevance and validity.

Feedback from peers is usually not very structural or formal. Nevertheless, students always discuss with their peers about the courses, exams, and assignments, which help them to evaluate how they succeed compared to other students. This kind of feedback may also help at expanding student's own perspective: they may notice that other students have different learning outcomes even though the learning context and learning material have been quite similar. This kind of feedback is usually not absolute, but rather a relative indicator of learning outcomes (this also applies to scores and grades given by the teachers, even though students sometimes may consider teachers' feedback more objective and absolute). One interesting example of how students can get feedback from their peers on their own strengths is described in Roberts et al. (2005). This exercise is in use in the course Leading and understanding oneself (TU-53.1207). Every

year students find this exercise both fun and useful. In this exercise students are requested to ask feedback on their strengths (not weaknesses or skills that need to be developed) from people who know them well (parents, siblings, friends, etc.). This feedback is given in written form and this feedback should also include examples how the strengths are manifested in reality. After collecting this feedback, students evaluate in their reflection essay how they can utilise their own strengths in their studies or when planning their future. Even though this feedback of one's own strength does not usually generate big surprises, many students find it interesting to see how similarly different people see them. Many students also report that after this exercise they become more confident with their own strengths, and find out new ways to utilise their strengths.

Feedback from introspection means that a student evaluates her learning in an active and more or less structured way. Students often declare that they wish to get more external feedback on their performance and learning. Evidently university can not always fulfill all the students' wishes, and therefore it is essential that students develop skills that enable introspection associated with their learning. In reflective introspection a student has a great authority to set a reference point for learning. The role of a teacher is to help the student to set such reference points that are not too easy or overwhelmingly demanding.

Some theoretical approaches with practical guidelines to introspection through *reflection* and reflective learning are introduced in e.g. by Moon (2005) and Ash & Clayton (2004), but there are perhaps many other feasible methods as well. Various kinds of reflective learning methods are probably applied differently in different Aalto University courses. This can be confusing and burdening at least to some of the students, because they need to find out what are the expectations in that particular course they are taking. From an educational perspective this is a question of the balance between organisational formality and structures, and teachers autonomy.

This type of feedback channel (introspection through reflection) can be inherent to some students. However, some students lack the ability to systematically reflect their experiences and learning. Thus, teaching methods and structures may help at building and opening this type of a channel. Usually explicated evaluation criteria in courses guide students in their learning. SOLO taxonomy (Structure of Observed Learning Outcome) is one general type of evaluation criteria. These criteria are used at least in some of the Aalto University courses for helping students to write e.g. their learning journals. The criteria is first introduced to the students and then applied in assessing and scoring process. So, using SOLO taxonomy has at least two benefits. First, it helps students to organise their thoughts and understand how their learning is linked to their prior knowledge. Second, it gives teachers an easy template for assessing and grading students' outputs.

All of these channels of feedback are important (they may have different value and benefits in different phases of the studies), but university education should help students at developing methods and mental models that strengthen their capability to use introspection as an instrument to assess their cognitive, technical, and meta-cognitive capabilities.

2.2 University's role in improving students' self-knowledge

Learning methods and learning processes have enormous impact on what students learn and how, but also on how students are able to develop their self-knowledge. University education should not focus on *what the student is* or *what the teacher does*, but instead focus on *what the student does* (Biggs & Tang 2011). This emphasizes the active role of students. Luckily, it is very common nowadays in Aalto University courses that *active approach to learning* is either encouraged or even demanded.

Distinction between deductive and inductive methods/approaches to learning/teaching is one way to describe two very different orientations to university education. The deductive approach is very teacher-centered while the inductive approach is very student-centered. In its strategy, Aalto University has indicated an intention to become more student-centered. Thus, learning/teaching should become more inductive oriented as well.

Inductive learning methods including e.g. problem-based learning, project-based learning, case-based teaching, etc. (Prince & Felder 2007) have become more common in university education. This applies to Aalto University as well. Unlike more traditional deductive methods, inductive methods help the students to build more vivid, multidimensional and accurate self-knowledge on their skills and abilities. This is because inductive methods involve more intellectual challenges and reasoning: necessity to analyze and synthesize information and active construction of knowledge and understanding (Prince & Felder 2007). However, inductive approach to teaching and learning can be challenging to teachers: it may mean that *normative evaluation criteria* for learning outcomes are no longer valid or only incompletely applicable. Teachers must accept that in the same course students' learning focus and scope vary. Students must understand this message as well. This kind of thinking may be already common in School of Arts, Design and Architecture, but more difficult to apply in other Aalto University schools where deductive approach has longer and stronger tradition.

If students are increasingly encouraged to take a role as active processors of information, this can lead to conceptual changes in students' thinking. Additionally, learning should be considered as a joint activity of students and teachers. Students and teachers obviously have different roles and responsibilities in this process, but the goal should be the same – to enhance learning. In order to facilitate students' own activity and motivation, Aalto University should provide opportunities and support for learning, not just answers or solutions. Teachers must be conscious and aware how their pedagogical choices affect learning. It would be unreasonable to think that all teachers are able or motivated to do so. Pedagogical training and collaboration among peers will help teachers in this.

A question then arises: does this active and inductive approach to learning improve students' self-knowledge? One could argue, with good reasons, that not necessarily. Therefore the platform of education should also offer tools and methods that assist students to *become more aware* of their self-knowledge. Reflective study and learning methods (described in more detail in Chapter 3) definitely help in this process.

There are nowadays many technical applications that help us getting information of ourselves. Many people who do sports and physical exercises measure what they have done, how this affected to their body, and how they have developed over time. Also for example the quality of sleeping can be monitored through a technical device. Cognitive constructs like self-knowledge can be analyzed and gained via technical applications too. The boxed example below illustrates how this can be done.

Example!

One example of non-traditional method of an attempt to monitor and analyse one-self is introduced in the course Leading and understanding oneself. In that course students use Emotion Tracker (http://emotiontracker.fi/home/) for few weeks. The application helps students to recognize and analyze their emotions and evaluate how their emotions affect their mood and behavior.

Afterwards, students write reflective learning journals and evaluate their emotions. In their reflective learning journals many students have been rather sceptical toward this application in the beginning, but they were very satisfied in the end. They become aware how their emotions are associated with their every day experiences and they become more capable to deal with their positive and negative emotions.

There are several ways how students can develop their self-knowledge, and how university can support this process:

- By instructed reflection, students are able to identify their academic abilities and develop their self-knowledge (Rusche & Jason 2011).
- Learning journals help students at reflecting and evaluating their personal learning process and outcomes (Morrison 1996, Brown et al. 1997).
- Two already existing courses in Aalto University especially focus on facilitating development of self-knowledge: TU-53.1207 Itsensä tunteminen ja johtaminen (Leading and Understanding Oneself) and TU-53.1150 Filosofia ja systeemiajattelu (Philosophy and Systems Thinking).

If Aalto University wishes to integrate teaching (and learning) of different kinds of transferable skills (including self-knowledge) in its curriculum, it should be considered also from *change management* perspective (Drummond et al. 1998). It is not enough that policy makers demand that curriculum should contain learning objectives regarding different transferable skills, but the implementation of this must be supported. Fortunately, Aalto University is already taken serious initiative for example in pedagogical training of its teaching staff.

Self-knowledge development is incremental and it is a life-long process. People develop self-knowledge even without conscious efforts. However, there

seems to be methods and practices that promote development of self-knowledge and therefore students should have opportunities where they can consciously assess and develop their self-knowledge.

In this report we aimed to elaborate how different transferable skills could or should be integrated in the content curricula or courses. Students should gain skills for how to evaluate and develop their self-knowledge from the start of their studies. The large number of students taking the course Leading and understanding oneself every year somewhat indicates that there is room for an independent course on self-knowledge. In addition to that, students should learn how to initiate and apply introspective feedback methods by themselves later in their studies and life. Moreover, it may be possible that some content courses introduce methods that may help students to improve their self-knowledge. Anyway, there are probably only limited opportunities to integrate self-knowledge development into content education and courses.

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3. Reflective learning

Paula Ahonen-Rainio

This chapter studies the skill of reflective learning and how teaching in Aalto University, as in any university, can support the development of this skill. First, as a motivation, the need for this skill is presented and the concept and models of reflective learning are introduced on the basis of literature. Then, the key aspects of reflective learning that should be taken into account in teaching are covered and commonly used teaching methods relying on and developing the skill of reflective learning are discussed. The chapter concludes with some recommendations for supporting the development of reflective learning skill in the context of content teaching in Aalto University.

3.1 Need for the skill of reflective learning

Life-long learning is an essential element of modern working life and professional development. Changes in society are rapid, and the amounts of information as well as the complexity of decisions are increasing. Therefore, good learning skills are not only an advantage of students when studying at the university but an important asset when the students move on to working life. University education should encourage students to self-directed learning development so that, at the point of graduation, they are ready to continue learning without immediate support of teachers. However, according to the annual survey of Tekniikan akateemiset (TEK, 2014), recently graduated students of Aalto schools of technology experience their skills of life-long learning somewhat lacking.

Reflective learning (or reflective practice) has been identified as an essential component of professional development and life-long learning (Finley, 2008). Reflection, a metacognitive skill that we apply consciously or unconsciously in everyday life, is an essential activity in learning, and it also plays a crucial role in self-knowledge and critical thinking. In this paper, refection is considered as a conscious activity in the context of deliberate, intentional learning with a specific goal. Conscious reflection is necessary because it allows us to make active and aware decisions about our learning (Boud et al., 2013, originally published in 1985).

It is difficult to survey the extent in which reflective learning is taught in Aalto University. First of all, transferable skills such as reflective learning are barely mentioned explicitly in curricula, and the many varying ways the learning objectives are expressed make it difficult to automatically analyse from the texts

whether the skill of reflective learning is intentionally taught in parallel to content. Second, the idea of reflective learning is embedded in many teaching methods, but the courses are described content-wise rather than by teaching methods. Furthermore, using a certain method in teaching does not automatically lead to the development of this skill if the concept of reflective learning is only vaguely understood and seen just as solitary introspection, both by teachers and students. Therefore, pedagogical education that develops this understanding among teachers might serve as an indirect indicator of the extent in which reflective learning is taught in Aalto University. This kind of estimation is not done here though. Instead, this chapter concentrates on clarifying the concept of reflective learning and how teaching, in general and by certain teaching methods especially, can be used to support the development of this intrapersonal skill.

3.2 The concept and models of reflective learning

Reflective learning, at the core of learning skills, implies learner's active engagement in the process of identification of a problem or an experience, deliberate decision to solve or examine it, collection of additional information regarding the issue, achievement of the outcome of changed thinking, and acting with this new understanding. Some commonly referenced theories and models of reflective learning are presented below in order to clarify the essential characteristics of reflective learning.

3.2.1 Key elements of reflective learning

Rogers in his synthesis of several theoretical approaches to reflection in the context of higher education (2001, 41) identified the common definitional elements of these theories as the following:

- Reflection requires active engagement.
- Reflection is triggered by an unusual or perplexing situation or experience.
- Reflection involves examination of one's responses, beliefs, and premises in light of the situation at hand.
- Refletion results in integration of the new understanding into one's experience

Moon (2005), without of emphasizing immediate experience, describes reflection as a mental process that is applied to gain a better understanding of relatively complicated or unstructured ideas and prompted by a purpose or an anticipated outcome. Furthermore, reflection involves reprocessing of our already existing knowledge, understanding, and possibly emotions. Possible outcomes of reflection are, for example, action or other representation of what was to be learned, a critical review, the development of theory, decision, and resolutions of uncertainty, or ideas that may solve the problem that triggered the process.

3.2.2 Reflective learning from experience

Reflection has been widely considered in the context of experience-based learning, where it is embedded in the process of reflective practice. It is understood as the process of learning through and from experience (Bould et al. 2013/1985). The idea of reflective thinking in relation to the learning process was discussed already in 1933 by Dewey who, as cited by Finlay (2008), considered that reflection springs from doubt, hesitation or perplexity related to a directly experienced situation and involves careful, critical consideration of taken-for-granted knowledge.

A well-know model of Gibbs' reflective cycle (presented 1988) progresses via (1) the description of what happened and (2) what were the learner's feelings, (3) the evaluation of what was good and bad, (4) the analysis of what sense the learner can make of the situation, to (5) the conclusions, and (6) the action plan for the next similar situation. The model is explained, e.g., by Lia (2014) who also gives practical instructions about how to follow the steps of the model when writing course work.

Boud et al. (2013/1985) emphasised the importance of first returning to the experience (cf. description in Gibbs' model) and attending to feelings before re-evaluating the experience in order to save the learner from false assumptions or reflecting on information that he/she does not have comprehended sufficiently. They also pointed out that some value of reflection may be lost if not linked to action but also recognise that some outcomes of reflection are intangible or applicable only in the long term.

Another widely promoted model is Kolb's Experiential Learning Cycle that in four phases follows the structure of human brain and applies different learning modes accordingly (Kolb and Kolb, 2005).These phases are (1) concrete experience, (2) reflective observation, (3) abstract hypothesis, and (4) active testing. Kolb and Kolb (2005) remark that all learning is relearning. Therefore, the process of learning should be facilitated so that learners' beliefs and ideas can be examined, tested and integrated with new, more refined ideas. In addition, conflict, differences and disagreement drive the learning process, so that the learner has to consider opposing viewpoints and find the resolution of conflicts.

3.2.3 Reflection at the core of deep-approach learning

Reflection is a fundamental component of *deep-approach learning* (Marton and Säljö, 2005) where learners relate new material to what they already know and which thus requires them to reconsider their earlier knowledge and modify it. This is in line with the idea of relearning above, but without the emphasis of an experience as a starting point of learning. The deep-approach learning arises from interest, motivation and effort of the learner to understand the meaning of the material. The learner is willing to integrate it into his/her previous ideas, and even reconsider and alter the previous understandings if necessary. As the opposite, reflection seems not to be involved in learning with a surface ap-

proach, in which memorising the material for the moment is the aim, and without any lasting purpose, no links between new information and earlier knowledge are created.

Moon (2005, 6) named five stages of learning that form a kind of continuum from the surface approach learning (the first two stages) to the deep-approach learning, developing deeper stage by stage. The stages are the following:

Surface approach

Noticing: Representation of the learning material is as memorised, modified only by the degree to which it is forgotten.

Making sense: Representation is coherent reproduction, but only in relation to itself, not related to other ideas nor processed.

Deep-approach

Making meaning: Representation is of ideas that are integrated and well linked, but not much evidence of going beyond the given.

Working with meaning: Representation is reflective, well-structured and demonstrates the linking of material with other ideas which may change as a result.

Transformative learning: Representation demonstrates a strong restructuring of ideas and ability to evaluate the processes of reaching that learning.

Because a learner may choose a different approach to learning depending on the task or the situation at hand, as a consequence, the existing knowledge of a learner may be inconsistent. In the reflection process, the learner can also reprocess these inconsistencies and "upgrade" the earlier learning of surface-level knowledge (Moon 2005).

Re-presenting of learning is essential in reflective learning: when learners represents, they learn from the reprocessing. Eisner (1991), as cited in Moon (2005), even suggested that we learn differently from different forms of representation because with different forms of representation we exploit reflection differently. Moon (2005) gives an example of experimentation that is considered enhance learning: in experimentation learners are required to represent their learning in some meaningful activity, and are thus forced to adopt a deep approach to learning.

3.3 How to support reflective learning

3.3.1 Learning objectives and tasks direct learning

Learning objectives direct actions of teachers as well as students. Therefore, the intended development of the skill of reflective learning, or deep-approach learning in general, should be embedded in learning objectives whenever relevant. As a whole, deep-approach learning should be recognized as an objective already in the design of curricula and not only of individual courses.

In his revised version of Bloom's Taxonomy of Educational Objectives, Krathwohl (2002) suggests a two-dimensional framework that includes metacognitive knowledge in parallel to factual, conceptual and procedural knowledge, following the present understanding of cognitive psychology. Along the same line, he renames and reorganises the cognitive processes. In the new taxonomy, cognitive processes of "analyse" (breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose), "evaluate" (making judgments based on criteria and standards), and "create" (putting elements together to form a novel, coherent whole or make an original product) imply reflective learning.

The learning tasks at hand as well as the assessment of the tasks direct a learner choosing either deep or surface approach learning. Learners are more likely to adopt the deep-approach if they observe that it brings success in learning tasks instead of the surface approach. Therefore, it is most important how we design the learning tasks and assessment of learning. For example, there is evidence that learners improve their cognitive abilities when challenged with ill-structured material in learning (Moon (2005) citing King and Kitchner (1994)). So learning tasks involving reflection with complicated or ill-constructed material develop the skill of reflective learning, and that is directly transferable to tasks typical in professional lifes of those with academic education.

Tickle (2001) refers to earlier studies that indicate that engineering and scientific disciplines, at least initially, need a narrow focus on detail whereas studies of arts require personalized interpretation. These can be characterised as operation learning and comprehension learning respectively. As a focus on detail easily engages in the surface approach learning, learning tasks that require reflection are most important for students of engineering and scientific disciplines.

3.3.2 Give time to reflective thinking

Reflection slows down activity, as it requires the learner to process learning material and link it with earlier knowledge. While reflective learning requires time, the time used in reflection pays back in understanding and feel of owning the processed and represented knowledge. The estimations of workload should take into account this time learners require in reflection (Karjalainen et al, 2006). Overload with tasks or material has been shown to reduce the learning outcome and drive learners to memorizing details without refection that would enable understanding and long-term impact.

Reflective learning is typically associated with learning tasks such as writing journals or essays. Learners spend time on reflective learning over these tasks in privacy. However, reflection should also be part of lectures. This implies that time required for reflective learning should be taken into account when preparing lectures. Interviewees in this study found their efforts in support of reflection during lectures especially important. One of the interviewees described how he presents various approaches relating to the topic in order to stimulate reflective thinking, and then pauses and allows time for individual thinking. Positive, supportive atmosphere encourages reflection during lectures, and creating this

kind of atmosphere is an important task of the teacher. Another interviewee uses questions and concrete examples to trigger reflection. Questions made by students during a lecture are especially valuable and may initiate reflection of all other students as well.

3.3.3 Becoming an independent learner

It is important that learners are aware how the process of reflection can be facilitated. According to Main (1985) skill programmes that focus on learners' awareness of their learning processes seem to be more successful than those focusing on learning techniques. Boyd and Fales (1983), as cited in Virtanen (2010), found that bringing students conscious of "what was done naturally", i.e. reflection, already resulted in an intentional use and valuing of reflection by these students.

However, also examples of the opposite attitudes exist. "Authentic reflective learning" that is motivated by learners' own interest can be distinguished from "doing reflection" as an academic activity. Finlay (2008) argues that this "doing reflection" attitude may result from students' view of the learning tasks having no intrinsic meaning and lead to forced reflection – done only because the teacher wants – that is consequently superficial, strategic and guarded, and yet, even that kind of reflection has been found to be valuable for deepening understanding. By adopting reflective learning practises, learners can become responsible for their learning processes and independent of particular activities planned by teachers (Boud et al., 2013/1985).

3.3.4 Teaching methods that engage in reflective learning

Teachers need to create frequent opportunities for students to engage in reflective learning. Reflection is required in tasks in which the learner cannot just reiterate the learning material in the same format as originally but need to reprocess the ideas for the re-presentation of learning. This can be the guideline when selecting the methods for developing the skill of reflective learning along content teaching.

Commonly used methods in this sense are, first of all, methods involving reflective writing, such as, a learning journal (e.g., Virtanen, 2010), essays (e.g., Birney 2012), and a portfolio. A traditional exam can be used for reflective learning by attaching it with self-assessment, and a revision for examination provides an opportunity for reviewing previous learning and deepening learning by reflection.

In addition to methods that engage an individual learner, reflection and reflective learning can happen in dialog (e.g., Brockbank and McGill, 1998). Pair and group discussions, possibly with roles, debates, or peer assessment are examples of these methods.

Material of teaching methods for reflective learning, extracted from Moon, J. (2004), is available for free use as "Resources for Reflective Learning" (*www.cemp.ac.uk/downloads/resourcesforreflectivelearning.doc)*.

3.4 Assessment of reflection in learning

When development of reflective learning is an explicit learning objective, it should be included in assessment in parallel to content learning. However, these two easily mingle in students work; the aim of reflective learning anyway is to deepen the understanding of the content.

Hobbs (2007) argues that reflection and assessment are simply incompatible. Her concern is the very nature of reflection that it is not really useful if forced, and students choose to reveal only those ideas or attitudes that the assessing teacher might look on favorably or else generate strategic opinions. However, for example, Ash and Clayton (2004) suggest that the reflective texts resulting from their Articulated Learning process that guides students in reflection can be used in assessment of the quality of thinking.

Birney (2012), when concerned about assessment of reflective writing with varying qualitative criteria, carried out a research which resulted in a set of indicators ranked according to the depth of reflection. She then analysed the content of reflective blogs and journals and found a correlation between the quantitative score given based on these indicators and linguistic richness and specific features of the texts. She proposes that understanding of the structure of reflective writing in this line can help development of automated writing evaluation and intelligent tutoring; she observed that improvement in reflective writing over time correlated with provision of feedback.

In the context of reflective learning, self-evaluation can be considered as an integral part of the actual reflective process. The interviewees in this study gave examples of how they use reflection in their own professional practise. One interviewee emphasised the role of a framework that defines levels or steps of development: comparison of one's knowledge or skills with the framework helps becoming conscious of one's own development and need for further learning. Another interviewee mentioned personal development plans for various time spans as a reference for self-evaluation. So the skills of reflective learning and self-evaluation should develop in parallel along the studies so that the role of external grading diminishes; this is important for students as they before long move on to working life.

3.5 Support for reflective learning in Aalto University

Reflective learning means active engagement with new material, reconsidering the earlier knowledge, working on confliction and opposing viewpoints, and reprocessing and representing the material instead of reiterating it. The skill of reflective learning can be advanced both by students being aware of how the process of reflective learning can be facilitated and teachers understanding what kinds of tasks encourage and require reflective learning. Reflective learning takes time but results in learning with long-term impact.

The strategy of Aalto University implicitly indicates that graduating students shall own good skills in life-long learning and professional development. These

same skills are needed already during the university studies. Therefore, the development of these skills should be explicitly taken care of. The following suggestions are steps in this direction:

Material to students about learning skills is already available in Finnish (https://into.aalto.fi/display/fiopiskelutaidot/Etusivu) via Into, a portal for Aalto University students into information relating to studies. However, it should be made more visible. Now it is linked to the pages of the psychology service, which may not be an obvious site for students to look for it. Furthermore, the same information is needed in English for the foreign students in Aalto.

As a part of the orientation programme of new students, reflective learning should be considered in parallel to the already available teaching of reflection for self-knowledge. This part of the orientation should be available to both bachelor and master students, and both to Finnish and foreign students. Some of the foreign students need more teaching in learning strategies because of their background in a different learning culture.

The pedagogical education of teachers plays a crucial role in development of the skill of reflective learning. Teachers should be made aware of the concept and its implementation in teaching methods and assessment. In addition to strengthening this topic in pedagogical courses, easily accessible material to teachers should be provided. It should be visible and easily accessible in the working environment in the same way as the web pages to students.

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4. Critical thinking

Joni Tammi

Critical thinking (CT) is a process where the thinker approaches a topic **actively**, **reflectively**, **systematically** and **purposefully**. Critical thinking involves open-minded yet logical and objective evaluation and analysis of evidence, while remaining mindful of various assumptions, biases, and subjective effects, including the possibility of committing logical fallacies and other "errors" in thinking. Typical aims for the CT process range from relatively simple tasks of recognising the objective from the subjective, to very general aims of deciding what to believe or what to do.

Many universities include CT in their graduate outcomes or values, and Aalto University is no different: "Freedom to be creative and critical" is listed as the second core value in the university's strategy[3] and CT is cited as one of the main factors behind the university's student-centred teaching[4]. The skill of being critical or thinking critically is also recognised important in the working life, and graduated students often name it as one of the most important skills – but at the same time the students feel the critical thinking is not taught or practised to a sufficient degree during their studies (Tekniikan akateemiset 2014). In fact, critical thinking is also often named as one of the important skills a graduating engineer is missing (e.g., Keltikangas 2013). This is not surprising, as CT is not taught in Aalto as a separate course, and the courses where it is mentioned as a learning outcome, are often advanced or highly specialised courses (Masters or Doctoral level) and thus not helping early-stage students to start developing their CT skills for their studies.

So there clearly is a need 1) for the graduating students to have strong critical thinking skills for their future work and their life in general; 2) for Aalto to ensure its vision is reached; and 3) for the industry and the employers to have people who are also capable of active, systematic, analytical and error-free thinking and problem-solving skills. But it seems that this need is not fully met by the current degree programmes as a whole.

How can we strengthen the teaching of critical thinking skills on a larger level over a wider time span? What can a teacher do to incorporate CT skills on her course? How could an individual lecturer support learning of these skills – not as something separate that eats away her precious lecture time, but as something that also enhances the students' learning of the substance matter? And what *are* the CT skills in the first place?

[3] "Mission, Vision and Values", http://www.aalto.fi/en/about/strategy/ (cited 1.11.2014).
[4] "Studies." http://www.aalto.fi/en/studies/ (cited 1.11.2014)

In this chapter we begin with discussing the last question first, and work our way through the necessary working theory down to practical hands-on suggestions that can be applied on various courses and topics.

4.1 On Critical Thinking – Theory

Critical thinking, as almost any skill, can be often applied to simple cases without the thinker being concerned with the theoretical aspects of it, but as is the case with fields such as music, architecture or electrical engineering, becoming aware of the underlying theoretical foundations, the vocabulary, and background, allows one to both appreciate and initiate wider, deeper and more advanced applications. Thus, we begin by defining what we mean by CT skills.

4.1.1 Definition(s) of Critical Thinking

It is easy to understand what is meant by critical thinking, but it has been a challenge to define it accurately. Going through 25 text books written on the subject, Griggs et al. (1998) summarised their definitions for critical thinking as "*a process of evaluating evidence for certain claims, determining whether presented conclusions logically follow from the evidence, and considering alternative explanations.*" and note that "*Critical thinkers exhibit open-mindedness; tolerance of ambiguity; and a skeptical, questioning attitude.*"

In their *Glossary of Critical Thinking Terms & Concepts*, Elder & Paul (2013) describe CT as *"Thinking about your thinking while you are thinking in order to make your thinking better; more clear, more accurate, more reasonable, and so forth."* (p. 17), and as a "*systematic way to further* sound *thinking and limit* unsound *thinking*" (p. 3).

There are many other definitions, but the recurring themes concentrate around logical and analytical thinking on one hand, and objectivity, self-awareness, and reflectivity on the other. Regardless of the emphasis (toward logics vs. toward reflectivity), everyone seems to agree that CT is a "higher-order thinking skill" and as such, a demanding skill to teach, as it relies on many lower-order skills.

As a pedagogical side note, it is important to notice that due to the reflective and higher-order nature of CT skills, many teaching and learning methods requiring CT also almost automatically involve many other higher-order thinking skills in Bloom's taxonomy (Renaud & Murray 2008). Furthermore, comparing the definitions of CT to the different levels of the Structure of the Observed Learning Outcome (SOLO) taxonomy (e.g., Biggs & Tang 2011), it is easy to see that CT tasks penetrate through the different levels of the taxonomy. This should make them appealing for any teacher seeking to align their teaching methods with either model (Bloom's or SOLO), as incorporating CT-improving teaching methods in one's teaching does not necessarily reduce the learning of the subject matter, but may in fact *increase* it.

For the working model for the rest of this chapter we will adapt the definition created in the so-called Delphi report (Facione 1990). For this report, nearly

fifty experts from different academic disciplines across the North America collaborated for two years in a project conducted on behalf of the American Philosophical Association in order to produce a consensus definition and description for critical thinking. The group was able to distinguish six core skills or areas that are involved in critical thinking. The skills and their descriptions are given in Table 4.1.

Table 4.1. The six core skills/parts of critical thinking, adapted from the Delphi report (Facione 1990).

Skill	**Sub-skills**	**Learning outcomes; what we want the students to learn**
Interpretation	Categorisation; Decoding significance; Clarifying meaning	To comprehend and express the meaning or significance of a wide variety of experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures or criteria.
Analysis	Examining ideas; Identifying arguments; Analysing arguments	To identify the intended and actual inferential relationships among statements, questions, concepts, descriptions or other forms of representation intended to express beliefs, judgments, experiences, reasons, information, or opinions.
Evaluation	Assessing claims; Assessing arguments	To assess the credibility of statements or other representations which are accounts or descriptions of a person's perception, experience, situation, judgment, belief, or opinion; and to assess the logical strength of the actual or intend inferential relationships among statements, descriptions, questions or other forms of representation.
Inference	Querying evidence; Conjecturing alternatives; Drawing conclusions	To identify and secure elements needed to draw reasonable conclusions; to form conjectures and hypotheses; to consider relevant information and to deduce the consequences flowing from data, statements, principles, evidence, judgments, beliefs, opinions, concepts, descriptions, questions, or other forms of representation.
Explanation	Stating results; Justifying procedures; Presenting arguments	To state the results of one's reasoning; to justify that reasoning in terms of the evidential, conceptual, methodological, criteriological and contextual considerations upon which one's results were based; and to present one's reasoning in the form of cogent arguments.

Self-regulation	Self-examination; Self-correction	Self-consciously to monitor one's cognitive activities, the elements used in those activities, and the results educed, particularly by applying skills in analysis and evaluation to one's own inferential judgments with a view toward questioning, confirming, validating, or correcting either one's reasoning or one's results.

An alternative and often used approach to CT is to consider how CT is applied to different kinds of work or activities, for example critical writing, critical reading, or critical listening. In all of these, however, it is the skillset given in Table 4.1. that contributes to CT skills, and the only essential differences come from the differences of the mode of communication.

One can also approach the CT skillset by studying how CT it is used *as a whole*, instead of focusing on different specific skills. For example, Elder & Paul (2013) argue that one's approach to CT can be considered in terms of four dimensions or polarities, or as eight main types of critical thinking: implicit vs. explicit, sporadic vs. systematic, specialised vs. wide, and "Sophistic" vs. "Socratic" (see Table 4.2 for details).

The latter alternative in each pair can be seen as more advantageous or desirable in some cases, and the respective attributes can indeed have apparent benefits. For example, making the thinking process more explicit (and less implicit) enables the thinker to identify problems in his thinking because the thinking process has become just that – explicit. Similarly, one might hope that all students would seek to learn CT skills for "Socratic" purposes instead of "Sophistic", i.e., to become better thinkers rather than to learn how to manipulate others. The polarities are not, however, intended as a "bad vs. good" divisions, and one's use of CT skills can vary from one mode to another depending on the application. Furthermore, some polarities and attributes, such as specialised critical-thinking methods within a certain domain, can be already part of the subject knowledge.

Table 4.2. The four polarities (eight types) of critical thinking, according to Elder & Paul (2013).

Defining question	**Polarity**	**Description**
How conscious the thinking process is, i.e. whether the thinking is …	implicit	involves skilled thinking, but without being consciously aware of the process
	explicit	involves conscious awareness of the need to improve one's thinking skills
How systematically the thinker uses CT, i.e. whether the use of CT tools is …	sporadic/ episodic	the thinker has the ability to think critically "every now and then", but not systematically, leading to fragmented "thinking quality")

	systematic	involves organised and systematic application of all available "thinking tools").
How wide (or, on the other hand, specialised) the use of CT skills is, i.e., whether the use is …	one-dimen-sional/ specialised	skilled thinking within a subject or domain
	global/wide	generalizable CT skills that work across disciplines
What are the motives or factors driving the develop-ment of one's CT skills, i.e. whether they are …	"Sophistic"	studying CT skills, logics, fallacious argumentation, biases etc. to find these faults in other people or to "trick" them into accepting poor logic as good
	"Socratic"	studying CT skills to recognise these faults in oneself in order to improve one's own thinking

4.1.2 Critical-thinking-specific teaching concerns

Some transferable skills are very effectively taught alongside and integrated into the subject matter, when students learn the skills purely or mostly by applying them in real-world problems. For critical thinking, however, research comparing different CT teaching methods has shown that practice alone does not lead to best results, but a combination of theoretical background *followed* by practice is needed (van Gelder 2005). In other words, in order to maximise the students' learning of CT skills, a separate course or a series of lectures introducing critical thinking on a theoretical level, could be justified early in the studies.

There is also a risk involved in emphasising and promoting critical thinking too "uncritically". Namely, when focusing on critical, logical, and rational thinking, it becomes easy to dismiss the importance of creativity and intuitive thinking processes. Treating CT as the only tool for thinking (instead of as one of many), or demanding that every step needs to follow logically from the previous ones, the student may focus too much on what we already know, and not on what new we could make out of the situation. Confusing critical thinking and pure logic, thus, can lead to "Vulcanisation" of the students (Walters 1990); making them think like the Vulcan Mr. Spock in Star Trek: flawlessly, but "inside the box".

4.2 Teaching Critical Thinking Skills – Practice

Effective learning requires both theory and practise. Critical thinking skills are no different than, say, mathematical skills: one does not learn calculus by just reading about integrals (theory), or by being handed a problem sheet and told to start practising (practice). Mathematical education starts from basic theoretical concepts, which are then applied in practice, before moving to more advanced concepts and more difficult (realistic) problems. Critical thinking skills

are just the same. The rules, conventions, and the vocabulary are needed first; then practice – neither alone is enough for optimal learning of CT skills (van Gelder 2005).

An interested reader can easily find many practical ways to integrate CT skills into her teaching by a literature search, or by seeking for methods online. A good starting point is the website of The Critical Thinking Community[5], where one can find both introductory material as well as suggestions for further reading. For a detailed discussion and starting point on different teaching methods for both teaching CT as a skill as well as using CT to improve subject matter learning, I recommend the book "Critical Thinking across the Curriculum: Building the Analytical Classroom" (Maiorana 1992).

In addition to concrete tools for teaching, the teacher can also affect her teaching by adopting a "CT-aligned" attitude, and actively promoting not only CT skills in (see Table 4.1), but also the disposition toward critical thinking. Below are three suggestions for the teacher who wants to begin promoting CT in her teaching, and three tools that can be experimented with in almost any kind of course or student supervision event.

4.2.1 Suggestions for the teacher

Suggestion 1: Lead by example.
Show your thinking, and actively use critical thinking vocabulary. When asking questions, use words and questions that link to specific CT skills, and name the skills or thinking processes you are referring to. Think out loud; "let's interpret these results", "what can we infer from these results", "what arguments can we come up for this assumption – how about arguments against?" Table 4.3 lists various questions that can be used to address a specific CT sub-skill.

Suggestion 2: Use complex questions.
Real-world problems rarely are simple questions with only one obvious answer, especially in fields such as engineering, economics, or design. Make the students get used to complex or "multi-logical" problems, where there may be many correct answers (or none!), or where the answer depends on various assumptions, values, or beliefs. "OK, that certainly is a one good explanation – what other things could explain the data?", or "Yes, and I see you approached this problem from an electrical engineering point of view. What do you think, would an architect arrive at a different conclusion?"

Suggestion 3: Accept failure.
In order to encourage combining creative and critical thinking, use wrong answers or failures as teaching opportunities. Review historical mistakes or failures, analyse why a prominent experiment or decision failed, and show how the development of your field is not made of one success after another, but of hundreds and thousands of failed attempts, lucky incidents, etc., and put them into historical context. To think that the Sun orbited the Earth is silly now, but what

[5] The Critical Thinking Community, http://www.criticalthinking.org (cited 1.11.2014).

observations convinced the pre-Copernican astronomers that the geocentric model is, indeed, the only plausible one?

Table 4.3. Questions to encage critical thinking skills (cf. Table 4.1). Adapted from the test manual for the California Critical Thinking Skills Test

Skill	**Questions for critical thinking**
Interpretation:	What exactly is happening? What does the new observation/data/result mean? How should we characterise/categorise this? What can I make out of this?
Analysis:	What is the specific claim? Why do you think that? What is your conclusion? What arguments do we have for/against? What assumptions do we need to make to accept this conclusions?
Inference:	What does the evidence imply? What conclusions can we make with the current knowledge? What explanations can we rule out? What alternatives haven't we yet considered? What additional information do we need to solve the problem?
Evaluation:	Why do you think this result is plausible/reliable/credible? Why do you think we can trust this source? How strong are those arguments? How confident can we be in our conclusion?
Explanation:	What are the specific results here? Why do you think X is the correct answer? Can you explain how you came to that conclusion?
Self-regulation:	What haven't we taken into account yet? Are we precise, or is something still too vague? How good was the process/methodology/logic? How can we address any possible conflicts? What should have been done differently?

4.2.2 Teaching tools promoting CT in the classroom

Teaching tool 1: Socratic questioning.

There are various forms of Socratic teaching, but in its simplest form it can be used as a way of guiding the students' thinking to a right direction and allowing the students to come up with an answer or a solution by themselves. The teacher as a Socratic questioner works as the critical inner voice (questioning, assessing, analysing, self-regulating, etc.), making the thinking more explicit. In a sense the teacher is taking care that the CT skills are being used and practised in student discussions where the students' CT skills are still developing. The teacher is not solving the problems for the students, but showing the students what kind of questions lead to the answer. The method works well in teacher—student tutoring sessions and in small group discussions, but is has been shown effective also in online forum or email-based discussions (Yang, Newby, and Bill 2005).

The teacher's role in Socratic questioning is to ask questions, and following up answers and students' questions with more questions. This often requires expert knowledge or good preparation in order to select the right questions to advance the discussion. For practical tools and tips, see, e.g. "The Art of Socratic Questioning" by Paul and Elder (2007).

Teaching tool 2: Journal writing

Journal as a tool can mean many different things. It can range from an extensive learning diary to a 3-minute summary at the end of the lecture. As journals are usually written in the first person, they allow the writer to evaluate their own thoughts and feelings about the subject matter, thus becoming more aware of the distinction between her own feelings and thoughts, and the objective "facts" – one of the first prerequisites for critical thinking.

In short, writing a journal or any text taking a first-person approach to the subject helps the student to explore "thoughts underlying feelings and feelings underlying thoughts" (Garside 1994). Even a simple writing task during the lecture can help the student to clarify their thoughts about the subject, and the difference between those thoughts and feelings, and the "cold facts". The writing task can also give some students time to develop their own view on the subject.

Teaching tool 3: Self-assessment

Journal writing provides an excellent platform for promoting CT via self-assessment, but self-assessment can be encouraged also as stand-alone exercises. In a very simple form, it can involve the students assessing and grading their own essay or analysis against a grading rubric, consciously reflecting on how well their work demonstrates achieving different intended learning outcomes set for the exercise or the course. Students are used to teachers assessing and evaluating their work, but it often seems like few students are interested in taking an objective look at their own work unless instructed to do so, or merely remark "Yes I know, I always make the same mistake in this kind of problems" after they get back the results. In other words, they are not approaching their own thinking and their own work critically.

In our own research (Tammi & Lähteenmäki, in preparation) students report feeling that self-assessment tasks have helped them to become more aware of their thinking, and especially recognise areas where they need improvement. This, then, enables them to pay special attention to the problem areas, and recognise the threat of falling into the same trap the next time. Our future research focuses on resolving whether this translates to improvement in actual critical thinking skills, but we suspect that by improving the pre-requisites and areas of CT, the students also improve their CT skills in general.

4.3 Summary and discussion

Critical thinking skills constitute a skillset whose importance is recognised by the Aalto University strategy as well as the graduates, and their employers. At the same time, however, the graduates in particular feel that the level of CT proficiency they obtain during their studies is not adequate. In order to improve the

situation, the role of CT – like many transferable non-substance skills – needs to be emphasised in development of teaching.

In contrast to many other transferable skills, research shows that CT skills are most effectively learnt when the basic skills are taught separately, as a subject matter of their own. Furthermore, because the theory in this case should precede practice, students could benefit from some kind of an introduction to CT skills early in their studies, perhaps as a part of a more general "learning skills" course. However, as CT skills are easily transferable, they can be learnt on a general course first and then applied in practice over one's specialised studies, so the introductory course could be rather general.

A straightforward way to improve teaching a skill is to improve the teachers' expertise. In practice this could mean training teachers to become more aware of the basic framework behind critical thinking concepts and processes, and to incorporate them in their teaching. This could be achieved by a "Teaching for critical thinking" –themed module as a part of the university's pedagogical training, or incorporating it as an intended learning outcome in some of the pedagogical courses.

A clear and guiding way for the teachers and program leaders would be to clarify what we want the students to be able to, i.e., what intended learning outcomes we want to set for CT. On the basic level this can be done simply by defining different levels, e.g., "absolute minimum", "good working skills", and "pro", as tentatively named by Kettula & Ylitalo (2013). On the first level the student has the basic knowledge and skills required for using CT in her own work. On the second level, the outcomes are related to everyday working skills, and the third level deals with having a deep and wide understanding of the role of CT, and the ability to use the skills in evaluating her own work as well as with others. Examples for intended learning outcomes reflecting these levels are shown in Table 4.4.

Finally, there are also currently ongoing pilots for enhancing critical thinking as a university-wide programme (e.g., Broward College 2014). Reviewing their outcomes and experiences is likely to provide larger perspective as well as valuable tools for a higher-level improvement programmes.

Table 4.4. Examples for Intended Learning Outcomes (ILO) for three levels of CT skills. Adapted from Kettula & Ylitalo (2013).

Level	**Knowledge-based ILOs.** **The student is able to…**	**Skill-based ILOs.** **The student is able to …**
1	Describe why CT is important for an academic expert. Describe how her own values, beliefs and assumptions affect her thinking and decision making.	Practise problem solving within a CT-themed framework. Practise recognising these factors behind her thinking.
2	Understand the principles behind critical discussion (in contrast to winning a debate).	Assess the reliability and suitability of information sources in problem solving.

	Describe and recognise the most common logical fallacies in argumentation.	Analyse the validity of her arguments, and observe conflicts and fallacies in her own thinking.
3	Understand the role of questioning in developing her own expertise. Describe what kind of values, beliefs, assumptions and power structures are affecting the problem being solved, and how these affect the problem solving.	Question or assess critically the values, beliefs and assumptions related to decisions. Can address and take into account different values, believes, assumptions and power structures affecting the problem or the solution.

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5. Creativity

Kalle Palomäki

Creativity is the part of the human mind that drives progress in our society. Without a continuous stream of inventions we would not yet have even entered the Stone Age. In the world today creativity is mentioned among the key components in many societal contexts. When creative products have economic value they are called innovations. Indeed, innovation and the resulting economic prosperity is strongly emphasized in government policies, and in university and corporation strategies. Creativity is mentioned among Aalto University's values, and about 30 times in various contexts in the 30-page Aalto strategy document (Aalto, 2012). While creativity is valued in universities both in research and education, it is still not systematically nurtured. Yearly survey of skills needed in work-life conducted for engineering graduates also support the view that creativity is not well enough supported by education (TEK 2014, see Section 1). The support of education to creativity is rated around 3 in a scale from 1 to 5 while its importance is at 4. In fact, early work life seems to give slightly more support to creativity than education.

A Stanford advocate for creativity Tina Seelig is a popular author and world-known teacher in creativity. She argues that we all are born with amazing curiosity and desire to explore, but after kindergarten there is little support for creativity by society or education ranging from primary school to higher-level education (Seelig, 2014). In fact common activities in classrooms are likely to inhibit creativity rather than advance it (Beghetto, 2010). Questions and exercises in the classroom often have closed form and the "right answers" are sought as regard to "right knowledge". Answers that are creative, but not exactly right are easily considered wrong and are not explored further. Creativity would get more support from open questions that leave room for exploration. This could be demonstrated by primary school mathematical exercises. Let us consider a lake with a number of ducks. A closed question would be "There are ten ducks in the lake. Five fly out, how may are left?" A more open question would be, "There are ten ducks in the lake. Think of questions you could make out of that". The former defines a fairly determined process that leads finally to a single correct answer with a little room for exploration. The latter has no single correct answer but has infinite possible solutions and thus leaves room for exploration and more imaginative answers.

Creativity researchers agree mostly on three main components of creativity that are *originality*, *quality* and *relevance*. Thus creative ideas need not only to be new but also useful and relevant to the task at hand (Kaufman and Sternberg,

2010). Important in the Aalto context is the relationship between innovation and creativity. *Innovation engine*, a concept introduced by Seelig (2014) captures well the relationship between innovation and creativity, and environmental context that is fertile for innovation. Internal mental components of the innovation engine are *attitude*, *knowledge* and *imagination*, but it also requires external supporting components: *habitat*, *culture* and *resources*.

Creativity researchers agree on the principle that diversity of individuals in teams, or diverse knowledge background of individuals is among the factors boosting creativity. Creative ideas are likely to be born in situations where different fields intersect or combine. Therefore the concept of Aalto University combining universities in fields of arts, science and business holds a promise. Considering teaching benefits of the diversity of Aalto has materialized clearly, for example, in a number of cross-disciplinary courses and new work and study environments for creative works. In the present study we will address fostering creativity in the Aalto context addressing first a number of relevant theories of creativity, and related methods to foster creativity in education. Then we will conduct a quantitative survey of Aalto curriculum using keyword searches regarding how commonly creativity is mentioned in course content and names. Teaching at Aalto is also addressed by a few representative examples and interviews of teachers that have expended considerable efforts to foster creativity at Aalto. Finally we conclude in discussion.

5.1 Creativity theories

Creativity research approaches the concept of creativity associated with so called *divergent thinking*. It is a part of intellect that is separate of traditional intelligence measured by intelligence quotient (IQ) or by so called convergent thinking which seeks for the single correct answer. Divergent thinking (Runco, 2010) relates to generating ideas in a process of *ideation*. One of the goals of divergent thinking research is to make it measurable using psychometric tests like the Torrance test of creative thinking (Torrance, 1974). The relationship between intelligence and creativity is discussed by Kim et al. (2010) imposing the so called threshold theory. Up to IQ of about 115 IQ and creativity measures are correlated, but above the threshold the correlation is weak. Thus above 115 IQ explains poorly individuals creativity.

While the benefit of Torrance test is its simplicity, it has been criticized about its reliability. A more comprehensive assessment of creativity can be made using a newer tool consensus assessment (Baer and McKool, 2009) in which any product of creative work is assessed by a team of experts similar to scientific peer review. Performance in divergent thinking can be tested based on fluency, originality and flexibility of ideation. Fluency means efficient and fast generation of ideas, which may contradicts with ideas' originality. If people are instructed to generate as many ideas as possible then originality suffers. Successful divergent thinking has been found to correlate positively with success in life (Runco, 2010).

Creativity theories also define different magnitudes of creativity in the progression from *mini-C*, which is creativity in the normal learning process, everyday *little-C* creativity, professional *pro-C*, finally landing to big-C creativity corresponding to fundamental ideas, breakthroughs in science that lead to paradigm shifts (Simonton, 2010). Popular examples of big-C are important scientific theories such as theory of relativity by Albert Einstein. Mini-C creativity could be exemplified by processes in a child learning to read.

Kozbelt et al. (2010) classifies major creativity theories into ten different categories, namely *developmental*, *psychometric*, *economic*, *stage and componential process*, *cognitive*, *problem solving and expertise-based*, *problem finding*, *evolutionary*, *topologist* and *systems* theories. For example the developmental theory emphasized the interaction between person and environment in growth of child to adult, and addresses especially the mini-C to pro-C creativity. Psychometric theory addresses the measurement of creativity through psychometric testing. Problem solving and finding as well as stage and componential process and typological theories emphasize the creative process. Cognitive theory approaches creativity form the perspective of creative individual while evolutionary, economic and systems theory address creativity in the context of the environment.

Amabile (2011) discusses the relationship between creativity and intrinsic vs extrinsic motivation. Extrinsic motivation seeks rewards outside to solving problems at hand which could be money or good grade in studies. Therefore extrinsically motivated individuals seek quickest routes to rewards from simplest solutions that are not the most creative. In contrast intrinsically motivated people are enthusiastic about problems themselves and are more likely to seek creative and high quality solutions.

5.2 Creativity tools

Considering education and creativity training, Scott et al. (2004) addresses how various training programs enhance creativity. Their extensive meta-analysis based on literature about creativity programs shows with good confidence that creativity courses in universities generally improve an individual's performance in subsequent creativity tests. In the engineering education White et al. (2012) conducted experiments on the use of creativity tools and assessed students' creativity before and after utilization of the methods showing again enhanced creativity scores after utilization ideation methods in engineering design tasks. In the following discussion we will briefly introduce creativity tools for ideation and project-based teaching methods that are known to support creativity.

Ideation tools

The ideation tools are commonly classified as intuitive or logical (Shah et al., 2000; Table 1). Intuitive tools attempt to stimulate unconscious imaginative thought processes resulting in new unexpected solutions. Logical tools are based on science, engineering principles or solution catalogues such as patents. In the following we will first address intuitive and then logical tools.

Brainstorming (Osborn, 1963) is a popular concept and has become synonymous with any ideation session. Osborn's original brainstorming is based on deferring judgment to increase the quantity of ideas from which the four following rules were derived, 1) focus on the quantity of ideas to give a greater chance for radical solutions, 2) withhold criticism in the early stage of brainstorming and instead encourage participants to extend the ideas of others, 3) welcome unusual ideas from new perspectives, and suspend assumptions 4) combine and improve ideas based on the belief that a combination of two ideas may result in a single idea that is more valuable than the sum of its parts. Later Osborn's group version of brainstorming has been criticized that the social effects of groups tend to inhibit ideation and individuals working alone produce more ideas (Diehl and Stroebe, 1987; Mullen et al., 1991). Indeed, individual brainstorming methods such as **mind mapping**, have been developed to counteract the inhibitions.

Double team (tuplatiimi in Finnish) is a variant of brainstorming developed in Finland (Leskelä, 1994). The method starts with an individual ideation phase. Then ideas refined in pairs. The pairs will present the refined ideas to the whole team which selects the best ideas by voting. The progression step of pair work prevents the social inhibitions which occur in bigger groups used in some other forms of brainstorming. Therefore double team is effective for group sizes as large as 10-15 persons.

C-sketch (Shah et al., 2001) or **5-1-4 G** (G is for graphical) is a graphical ideation methods in which the *five* designers first produce *one* sketch of an idea which is then circulated to the *four* others with the purpose to extend, modify or delete some parts. No verbal communication is allowed. It is claimed that this kind of graphical ideation method represents mental imaginary better than verbal methods. Shah et al. (2001) also shows superior results using this method as compared to others in design tasks.

Table 1. Ideation methods summary.

	Team size	Ideas description	Suitability	Thinking style	Comment
Brainstorming	2-4	verbal	any team work	intuitive	productivity loss due to social inhibitions in big groups
Double team	10-15	verbal	any team work	intuitive	counteracts productivity loss in groups by starting from small groups and ending to bigger
C-sketch	6	graphical	graphical design	logical	has been found superior to tradition brainstorming for graphical problems
Logical methods	1+	verbal	anything building on history	intuitive	
Mind map	1+	verbal and graphical	creative writing		

Logical methods are based on two categories: historical and analytical methods (Shah et al., 2000). Historical methods use past solutions in catalogues of inventions such as patents as a basis for ideation. Analytical methods seek solutions from e.g. physics, causal relationships by systematic analysis.

Project and research based learning

Teaching methods wherein students act like researchers or professionals working on challenging real-world problems are also shown to increase creativity. The common variants of these methods are problem-based learning (Neville, 2009), inquiry-based learning (Brew, 2003; Alberta learning, 2004) and project based learning (Thomas, 2000). Sulaiman et al. (2014) demonstrate larger performance improvement in Torrance test for creativity for physics students who participated in problem-based learning than for students who were taught with more traditional methods.

Problem based learning was originally developed for medical students. A common version of it involves a seven step process (Neville, 2009) that progresses through terms and problem definition, to discussions on solutions but not necessarily leading to concrete products. It may involve also brainstorming in the phase where candidate solutions are sought.

Project based teaching (Thomas, 2000) commonly utilizes team-based projects which lead to more concrete products, designs or prototype, making it a feasible method for engineering education.

Inquiry based teaching (Brew, 2003; Alberta learning, 2004) is a wider term that covers both problem and project based learning, but it also may mean other types of approaches where students act like researchers. It can also be utilized in an open form where students need to define the research problems, not only solve them. Closely related to these approaches is a Finnish learning by doing research (Hakkarainen, 2001).

5.3 Creativity in Aalto University

Here we address, on what extent is creativity addressd in Aalto's curriculum. How is creativity addressed in some selected successful teaching efforts is also discussed. Correspondingly we address the creativity in Aalto's teaching in two ways. Firstly, we conduct an analysis of Aalto's curriculum using simple keyword searches. The aim of the curriculum analysis was to find out how commonly courses in Aalto have creativity in a way or another in their teaching plans. Secondly, we interviewed teachers who are known to take creativity seriously in their courses so that their examples could encourage other teachers in Aalto.

Creativity in Aalto Curriculum. For Aalto's curriculum analysis we used two different sources. The first is Oodi, teaching database used for enrolling to courses and for storing basic information about courses such as names, codes and short content descriptions. The second is Noppa, Aalto's web-site that is used for teaching in informing students about course schedules, and for sharing course material such as lecture slides and additional readings in in electronic

documents or multimedia files. In this study both Oodi and Noppa analyses were conducted based on keyword searches for creativity related terms. From the keyword searchers we conducted keyword frequency analyses for each school separately.

The study of Oodi was conducted so that first the course descriptions were collected in a MicroSoft Excel table each row representing course information that was then searchers using Excel's find tool. Hits for keyword "creativ" and "innov", that represent parts of all creativity or innovation related keywords, were calculated. If any part of the course information contained these keywords the course was counted as a positive occurrence. Figure 1 describes the results of the analysis in percent of occurrences of these keywords in the courses of each school. With the joint analysis of creativity and innovation in Figure 1 a, the most hits was obtained for School of Business in six percent of courses while School of Arts and School of Science were nearby. When we look at the results for creativity and innovation alone charts, we notice that School of Arts gets almost all of its hits from creativity related hits whereas schools of Business and Science get their hits from innovation related hits. This can be explained by the business content of schools of Business and Science studies. Schools of Engineering, Chemical Engineering and Electrical Engineering get less hits in either of the keywords suggesting showing that creativity or innovation are not strongly in their curriculum descriptions.

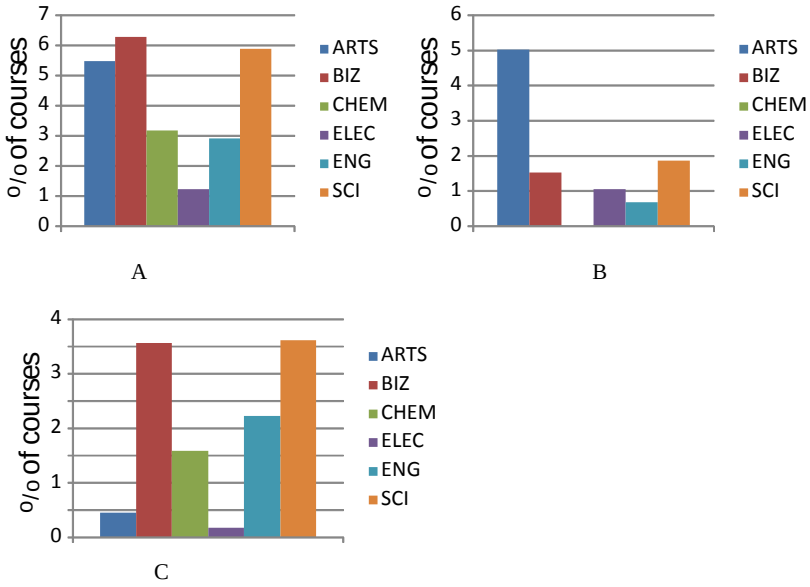

Figure 1. Aalto curriculum analysis using Oodi database for creativity and innovation related keyword searches. Hits on the keywords are shown as percentage course names containing the keywords. A. Keywords relating to both creativity or innovation B. Keywords relating to only creativity and C keywords relating to innovation only.

In Noppa the analyses were conducted using google site-wise search (Figure 2). The possibility to use Google's search engine also provided richer possibility in the use of keywords. Similar to Oodi analysis we show results for creativity and innovation related keywords, creativity without innovation related keywords and finally innovation without creativity related keywords. For creativity

we used many word forms of creativity, and creativity related teaching methods like brainstorming and ideation in both Finnish and English. For innovation we used innovation and invention related words in Finnish and English. For getting results specific to each school we used several alternatives of the names of each school. The results were normalized by total number of hits for each school using the same keywords including the school names without any creativity or innovation related keywords. We also discounted terms like "creative commons" related to software license and "Creative Sustainability" that relates to certain master's program. Just a mention about master's programs name does not mean that course would necessarily address creativity in its teaching.

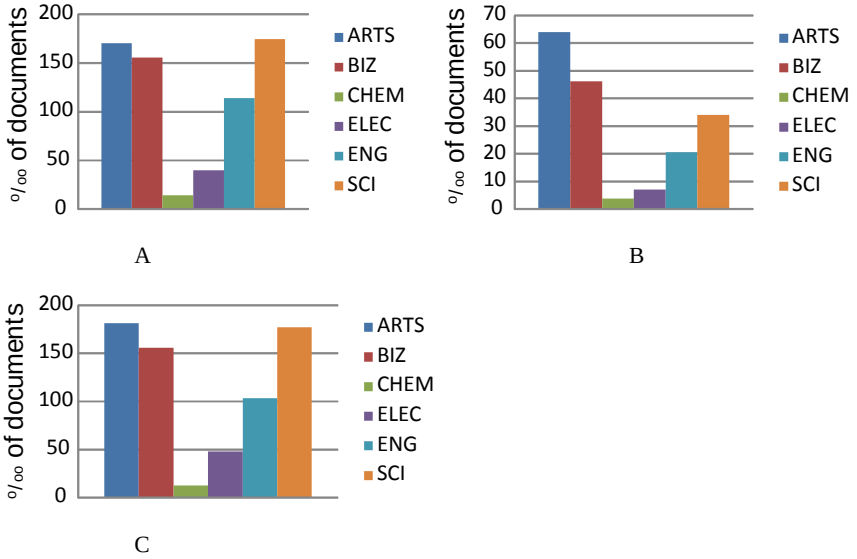

Figure 2. Curriculum analysis using Aalto's Noppa-webpages storing course material. Results are shown as per mille of retrieved web-documents containing the keywords in each school for A. creativity and innovation related keywords, B. only creativity related keywords and C. only innovation related keywords.

Interviews. For this study we conducted four interviews that consisted of three teachers utilizing creativity supporting teaching methods, and one external interviewee to discuss about theme Aalto as creative work and study environment. The first and second interviewees are teachers of multidisciplinary courses collecting students throughout Aalto. They use extensively creativity supporting teaching methods such as projects (Section 5.2) and team-based ideation (Section 5.2) in their teaching. The third interviewee uses creativity supporting research-based teaching method within students' own discipline.

5.4 Discussion

This study addressed the issue of fostering creativity in Aalto context. In this discussion we will first addres the keyword based curriculum analysis and the interviews. Finally we will discuss recommendations to Aalto's policymakers, teachers and students.

Curriculum analysis. The quantitative curriculum analysis used simplistic keyword searchers in course descriptions and material found in Oodi and

Noppa. The main observations were that schools of Arts, Business and Science were the strongest in fostering creativity and innovation in their teaching. The focus of School of Arts was stronger in creativity itself while schools of Business and Science were more innovation oriented. The School of Arts has interests in fields of arts where the economic impact is not necessarily the main issue which might explain why they are stronger in the use of term creativity.

One contradictory result we obtained between Oodi and Noppa analyses. A sharper drop of hits were obtained when creativity related hits were contrasted innovation related hits in the School of Arts. This result may be explained that the course descriptions in Noppa are richer and more regularly have co-occurring use of terms innovation and creativity. Rather different search tool was also used in these two cases. In Oodi the searches were based on finding parts of simple keywords, while in Noppa we used a rich set of keywords made possible by Google search.

One of the limitations of our approach is that we do not presently know precisely what the missing parts are or how many courses are missing. However, we note that we do have a considerable sample of the courses in each school, and each analysis is normalized by number of courses from each school that should counteract effects that relate to missing courses.

Another limitation of our analysis relates to the quantitative nature the keyword search conducted in by counting hits. Careful qualitative examination of the same material might give different results.

Interviews. Creativity could clearly be much more strongly in Aalto's curriculum and the teachers like the ones interviewed for this study could be role models for fostering creativity in Aalto University. Two of the interviewed teachers approach creativity in form of project- based learning conducted in multidisciplinary teams. As reviewed in the theory part of this study, the methods used by these teachers have several elements to support creativity: project based learning (Section 5.2), ideation (Section 5.2) and multidisciplinary teams all support creativity. Students in these courses need also to exercise problem finding known to support creativity. The teachers also give insights and advice on the utilization of the creativity methods. They point out that careful administration of creativity tools is important – teacher leading ideation should know what she or he is doing.

The third interviewee utilizes research based teaching method to foster creativity for students from the same discipline. Furthermore, this teacher enforces students to come up with their own solutions to solve a known research problem. This is a step towards real research manageable within a course study. The interviewees emphasize the need for educating attitudes of curiosity and ability see opportunities in their environments, and argue that universities should have a big role in it. The ability of spotting opportunities remains even if some of the learned knowledge comes outdated.

Like Seelig (2014) points out innovation and creativity require habitat and culture that supports creativity. Therefore we feel that it is also important to touch the work and research environment at Aalto. Considering creativity the connec-

tion of research and teaching is of utmost importance. As our second interviewee states creativity in universities lives mainly in research. Our fourth interviewee is critical to career and recruiting developments in Aalto and worries that fierce competition and new research evaluations hinder Aalto's possibilities to flourish as a creative work environment. Similar views are expressed in a study by Herbert and Tienari (2013) who interviewed Aalto's employees in a study of Aalto's new tenure track system. The effect of competition and evaluations may lead to extrinsically motivated researchers trying to optimize the measures rather than concentrate on creative research (Section 5.1., Amabile, 2011). The fourth interviewee also thinks that the new measurement and evaluation culture and part of careers, particularly lecturer track that does not allow connecting teaching and research. A similar issue is also pointed up by the third interviewee, who states that it is difficult to concentrate on education and learning as we are only measured by publication activity.

Recent report by European University Association on large creativity project suggests ways to build more creative in universities (EUA publ., 2007). Like the fourth interviewee they point out the importance of the measurement culture. They point out among the other things that measurement system should support forward looking attitudes, and also to reward risk taking, not only to look past achievements. In Aalto's evaluations measures like citations and publication rankings are emphasized, particularly the citation indices are past looking measures emphasizing importance of old publications. Importance on publication counts also does not support risk taking, as taking more risks also compromises the number of papers.

All the interviewees make a strong case about importance of diversity or multidisciplinarity. In fact the first and third interviewees have realized successful multidisciplinary courses that take students from all Aalto's schools. The third interviewee points out research facts that show that diverse multidisciplinary teams are more likely to produce breakthroughs while they may also be more likely to fail. The interviewees also acknowledge the potential Aalto holds to encourage multidisciplinarity, while especially the second and fourth interviewees are critical towards its current status. The fourth interviewee discussed that the research measurement culture favours focused research silos, where it is more certain to gain impact like citations, and offers this as explanation why multidisciplinarity is not innately supported.

Regarding the methods to encourage creativity often methods like ideation exercises are the first ones we tend to think. However, these methods consider only the work of creative teams and their time span is rather short, the couple of hours that the ideation session takes. In contrast, the many remarkable creative works such many scientific breakthroughs are results of hard work of creative individuals over long time. How to foster such kind of creativity? Seelig's (2014) advice on the Innovation Engine is good in this light. University like Aalto could affect all the components of on building external factor culture, habitat and provide necessary resources for creativity. Aalto's teaching could also affect more internal factors like build students' knowledge, affect their attitudes

as well as encourage their imagination. How to improve on these is addressed in the following recommendations.

Recommendations for curriculum level

Current situation: Presently creativity is Aalto's strategy several times, but is largely absent for example in general level curriculum descriptions.

Recommendation: Fostering creativity should be part of curriculum planning, their descriptions and that should be steered by the educational leaders.

Recommendations for course planning and teaching

Current situation: As the first interviewee points out, only a minority of Aalto's students ever experience creativity tools like ideation.

Recommendation: Creativity tools like ideation methods addressed in Section 5.2 should be part of Aalto's every student's learning experience and they should practice the use of these tools in several courses.

Current situation: Referring to interviewees Aalto's students (in engineering disciplines) experience a lot problem solving tasks in calculation exercises, but the problems tend to be predefined with unique solutions. Rarely will the students experience problem finding or solving open or ill-defined problems.

Recommendation: Students should start learning problem finding and solving open or ill-defined problems from the basic mathematics courses.

Current situation: Despite a couple of popular multidisciplinary courses majority of Aalto's teaching is within disciplines and we argue that Aalto fails to utilize its full potential to take advantage of multi-disciplinarity. Most of the Aalto's students still never experience these multidisciplinary courses.

Recommendation: Multi-disciplinary studies like multi-disciplinary project courses should be a part of every Aalto's students learning experience.

Current situation: Spaces utilized in Aalto's teaching are still mostly lecture halls or seminar rooms which hardly could be argued as venues for creative work. These spaces encourage traditional not so activating forms of teaching where teacher faces the audience.

Recommendation: Aalto's new learning spaces should take account fostering creativity. More of teaching and learning should occur in flexible spaces that could be alternated for creative experimentation.

Current situation: Project-based studies offer support for Aalto's students creativity, which they will encounter especially in in later stages of studies such as theses. However, projects still often have predefined problems to be solved.

Recommendation: Creativity could be fostered more concisely in the project works by offering multidisciplinary projects, encouraging problem finding and solving open problems. These activities could also start earlier.

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6. Teamwork skills for the studies and work life

Jukka Parviainen

In this chapter, we study how teamwork skills are and should be taught in higher education, especially at Aalto University. We start with a few motivating results. Next, we discuss more closely what we mean with teamwork skills in the higher education context. We use a literature review and interviews of experienced teachers at Aalto University to derive the synthesis and provide tips for academic leaders and teachers.

6.1 The need of teamwork skills

The need of teamwork skills is evident in the context of modern work life. Engineers, for instance, work in multidisciplinary teams to solve complex, value-added problems for clients (Crawley et al. 2010, 1). Working together efficiently and effectively in a team requires skills such as communication, leadership, negotiation and decision-making. We study how they should be taught in higher education to meet all the requirements.

We are examining teaching of teamwork skills in the context of the engineering schools at Aalto University. Each degree programme, for instance, Bachelor degree programme of Science and Technology, lists teamwork skills as one of generic skills and intended outcomes of graduated students. According to the study guide, a graduate knows the principles of teamwork and leadership of a group, is able to apply them to one's work, and is able to work as a member of his/her field in a multidisciplinary group. (Teknistieteellisen kandidaattiohjelman opinto-opas 2014.) The annual survey of graduates of Master of Science in technology provides an evaluation point. Graduates have self-evaluated that the teamwork skills in the work life are important (mean value 4.5 with the scale 1-5, N=1307 in Finland), and these skills, fortunately, have been developed through the education fairly well (3.8). In some programmes, e.g. Industrial Engineering and Management and Information Networks which include social sciences in their curricula, students have experienced that teamwork skills are taught thoroughly. The variation in the experiences among students in different study fields may also result from capabilities and earlier experiences of students.

We have counted the frequency of teamwork terms in the present curricula to see how teachers have expressed the need of teamwork skills in the learning outcomes, contents, methods and evaluation of a course. At least one of the

strings “group”, “team”, “project”, or “ryhmä”, “tiimi”, “projekti” (corresponding Finnish terms) with any extensions appeared in 548 (20 %) course descriptions out of 2745 all courses at Aalto University (without School of Arts and Design) in the study curricula 2013-2014. Most typically a compulsory course assignment was to be done in groups. However, it turned out that teamwork skills are not mentioned so frequently in the learning outcomes of the courses. The learning outcomes mostly focus on theoretical content knowledge and engineering skills of the field. Hence, it seems that there is not a lack of teamwork but a lack of systematic support. There are only a few courses which immerse in teaching group works skills. An example is “Individual in groups” (TU-C1010 Ihminen ryhmässä) which is a mandatory course for the first-year students in the first two above-mentioned programmes.

The work life today supposes that the employees possess good teamwork skills. Therefore there is a strong need for teaching and applying teamwork skills in higher engineering education. Good working life skills are good learning skills, too. The need has been observed and replied to some extent in the study programmes and curricula but how have they been implemented? Do teachers consider teamwork skills so evident that the profound skills are not actually taught anywhere? Do they have skills to teach and evaluate the success of the groups? Or even more, is the only purpose of group assignments to cut down the workload of the teacher?

6.2 Teaching teamwork skills in higher education

The Merriam-Webster dictionary defines the team work as “*work done by several associates with each doing a part but all subordinating personal prominence to the efficiency of the whole*”. In this definition, the group and its outcome are set as a primary target. Individuals carry out the work but the group collects trophies or falls into ruin. We use here the terms group and team interchangeably. The research related to the teamwork is often in the field of social psychology or work psychology.

Shortly, a group consists of two or more persons which have a common target. Groups can be defined in several ways. One definition includes four essential features for a team: interdependence of the others in the group, knowledge of being a member of a group, defined authority, and stability of the group (Arnold et al. 2010, 517). Groups can be official or non-official, formal or informal (Pennington 2005, 16). Each group has to confront and solve problems such as how to understand and accept targets, how to make decisions and divide responsibility, how to assess the success, how to deal with conflicts (Pennington 2005, 11). If some of these aspects are not clearly articulated then the risk of suboptimal results increases. Groups may lose effectiveness due to the motivation, coordination and intellectual costs (Helkama et al. 1998, 255; Using Group Projects Effectively). A group with a too strong leader, too homogeneously thinking members, or affected by external pressure may drift to group thinking with suboptimal decisions (Helkama et al. 1998, 282; Kerr & Tindale 2004). There are several interventions available to increase the effectiveness of a team.

These are related to team-member selection, team building and its training, developing leadership, and restructuring work (Handbook of Work Group Psychology 1996, 510).

The concept of teamwork skills in higher education is wide. Communications, active listening, negotiating, person's self-esteem, self-management, and self-regulation are often discussed in this context. The CDIO syllabus names two interpersonal skills: teamwork and communication. The teamwork is divided to five categories: forming effective teams, team operation, team growth and evolution, leadership and technical teaming. They contain about 30 items to be integrated and taught in the engineering education (Crawley et al. 2010, 261).

The literature uses sometimes interchangeably several terms for group learning methods in higher education: active learning, collaborative learning, cooperation learning, problem-based learning, and project-based learning. Learning can happen guided in-class, guided out-class, or student-driven in projects while the group can be official or non-official, formal or informal (e.g., Biggs & Tang 2011, 165; Johnson et al. 1998, 33-34). Formal groups are often stable and consistent in a course, and most of the work is carried out in projects outside the classroom without explicit instructions or control by the teacher. Informal groups are often used during the teaching situations to ensure that students process the topic cognitively (Johnson & Johnson 2002, 99).

There are plenty of great books for instructors about teamwork, such as Barkley et al. (2014), Lindblom-Ylänne et al. (2009), Repo-Kaarento (2010), Sahlberg & Sharan (2002), Tiberius (2013), and articles like Felder et al. (2000), Johnson et al. (1998), Johnson & Johnson (2002), Springer et al. (1999). In addition, there are web pages for teachers to design and implement teamwork methods in higher education (e.g., Collaborative Learning; Implementing group; Teaching teamwork; Teamworking skills; Working in groups). Most probably, any university with a pedagogical unit provides help for the personnel. They provide teachers tools and techniques for efficient learning with groups. However, beyond these instructions there is a number of attributes which affect teaching of teamwork skills. These attributes and findings from the literature are discussed next. They are categorised into three following sections:

- Curriculum and leadership level
- Course and teacher level
- Student level

Finally, a well-studied framework of cooperative learning is introduced.

6.2.1 The curriculum and academic leadership level

Teaching at the university is regulated by the curricula. A curriculum is designed for a certain content area. There are curricula for a physician, a software engineer, or a lawyer. Given a curriculum, faculty, students, their employers, and the society knows what kind of content knowledge and skills are to be taught. Students are expected to improve their teamwork skills cumulatively during

their studies because such skills are important in the work life. In addition, activating teamwork methods instructed by teachers are powerful tools in the teaching and learning situations in the context of student-centred approach (Discipline-based education research 2012, 120; Prince 2004; Springer et al. 1999). Therefore it should be clear that teamwork skills should be taught explicitly and evaluated throughout the curriculum.

There are several ideal constructions of curricula. Nykänen and Tynjälä (2012) provide three models of the curriculum design to incorporate transferable skills: specialist, integrated and networked model. For instance, the proposal for a computer science curriculum by ACM relies on an integrated form and it has incorporated some key factors inside substance courses (Computer Science Curricula 2013, 15). The CDIO approach contains a standard of a design of an integrated curriculum where each course has a function and an explicit plan to integrate CDIO skills, such as teamwork, to fulfil the requirements of the curriculum. In this way skills are trained in the real context. (Crawley et al. 2010, 77-80.) Another extreme is the project-based curriculum at Aalborg University, Denmark, where most of the contents and skills are taught in projects, or via "PBL – the Aalborg model", right from the first year on (Aalborg model 2014).

Another question is when the skills should be taught and used in the courses. Typically, the answer is the sooner the better. In practice, McGraw and Tidwell (2001) organised a three-hour workshop for all new MBA students entering university. Healey (1992) integrated transferable skills into a first year practical course and informed that it required lots of planning. Colbeck et al. (2000, 80) suggest teaching interpersonal skills right in the first introductory course so that students have positive experiences for the subsequent studies.

The proper curriculum work requires profound academic leadership, good discussion among the community of teachers, and endeavours from the faculty to implement the courses. If teamwork skills are one of several outcomes of the degree, then the most of teaching and learning of the skills should be explicitely mapped to several content courses in the integrated curriculum. This ensures that a student may not avoid learning skills accidentally, and the skills can be learnt systematically and cumulatively.

Pedagogical units at universities can provide tools, instructions and guidance for applying group work in teaching. Pedagogical training facilitates the faculty with interactive methods, and the skills are incorporated from bottom up in the curriculum. Jääskelä et al. (Yhdessä parempaa pedagogiikka 2013) have reported a sort of intervention at the university level. The umbrella project "Interaktiivisuus opetuksessa ja oppimisessa" (in English: "Interaction in teaching and learning") was launched by the pedagogical unit at the University of Jyväskylä. Active teachers from different disciplines participated the project and developed their own courses by experimenting different types of interactive methods, e.g., cooperative learning in chemistry (Lundell & Matilainen 2013) and small learning groups in a physics course (Tuovinen & Koskinen 2013). In this way, teachers implemented skills in their courses regardless of the top down curriculum planning.

6.2.2 The course and teacher level – practical implementation

The modern course design is often implemented under the concept of the constructive alignment where the teaching/learning activities and the assessment tasks are systematically aligned to the intended learning outcomes (Biggs & Tang 2011, 11). If teamwork skills are mentioned as one of the learning outcomes in the course, there should be teaching activities that support it, and the assessment criteria should take these into account.

There are lots of attributes that affect the success of the group work in teaching. The more the teacher is aware of them, the better are the chances for the success. A non-exhaustive list in Table 1 is based on a few sources (Collaborative Learning; Using Group Projects Effectively; Working in groups; Hyppönen & Lindén 2009; Biggs & Tang 2011, 165-166).

Table 1. Teacher's tools for instructing successful teamwork.

General issues	justifying the need of group work; motivation; written and/or oral instructions available; trade-off between covering less content vs group work; student's responsibility of learning; code of conduct and other common rules accepted
Project or assignment design	create non-trivial tasks that require interdependence; reserve facilities
Group forming	formal/informal; random/instructed, who composes, homogeneous/heterogeneous; size; ice-breaking activities, backgrounds of students (see Domik 2009); leadership (authority)
Monitoring and supporting	clear instructions; ask students for plans and timetables; reserve time for explicitly teaching teamwork skills (leadership, listening, commitment, self-knowledge, etc.); provide effective methods (brainstorming for new ideas; jigsaw, gallery walk and learning café for teaching other members); interventions (roles, changes)
Conflict-solving	how to deal with conflicts such as social loafing, free riding, dropping out, ineffectiveness, group-thinking, members dominating / leaving out; dealing with heterogeneous background (knowledge, skills, language, origin, gender)
Assessment of the group	grading individually or as a group; process or product; peer assessment (see Cheng & Warren 2000)
Self-evaluation	how did the group work, how did it manage with conflicts; grading

Mastering teamwork skills as well as teaching them is not an easy task. The success in a course requires teacher's time and resources. Michael (2006, 164) says that teachers become learners if they want to be implement methods successfully. The student-centred way of teaching shifts the responsibility of learning to students. Teachers do not have and they need not to have a full control on students' doing. Teacher should not interrupt or kill students' conversation and collaboration (Biggs & Tang 2011, 65). However, this does not mean that students should be ignored or left out without any control, help, or instructions.

They have to be instructed to work correctly and efficiently, for example, setting their own goals, planning the timetable and roles. Teachers guide the progress explicitly with pedagogical decisions or implicitly by letting students make choices. Some choices are problematic and may depend on the specific case, for instance, whether the teacher should form the groups, randomly assigns students to groups, or let students choose their mates (Colbeck et al. 2000, 81). Each student may have a priori orientation to working in a group which is difficult to change. There can be tough situations where the teacher needs to be adamant and explain the benefits of the procedure. Arkoudis et al. (2013) succeeded in increasing multi-cultural interaction in the course using a solid framework which encouraged interaction between cultural groups. In summary, the learning/teaching activities should proceed to real learning outcomes.

Teachers at the university meet pressure when they are dealing with trade-offs between their research and teaching. Typically, the progress in the academic career depends on the research performance. One option for minimising time in teaching is to use group works. Checking 10 assignment reports instead of 50 can be efficient, and part of the saved time should be reserved for teaching teamwork skills as well as for a good design of the group work.

Last but not least, active learning and teamwork in the beginning of the studies may help in student engagement and retention. Dropping out of a group may cause that a student abandons studies (Cartney & Rouse 2006).

6.2.3 The student level – student's perspective

Students recognise the need of teamwork skills. They have lots of negative, neutral, and positive experiences in working in groups before entering university. So, what does the teaching at the university give more? Johnson et al. (1998, 28) claim that in the agricultural environment children were born to work collaboratively whereas today's world is more orientated to individuals' success. There are certainly cultural differences which can be measured in a few dimensions such as individualism-collectivism, distance of authorities and avoidance of uncertainty (Pennington 2005, 26-27). In fact, as the teamwork skills form a complex network of different skills and knowledge, each student should feel that there is always something new to learn and experience.

Students are typically young adults who follow the curriculum given by their university. Students of the same programme form a large slack group by knowing each other at some personal level. This may help when building teams for different situations in courses. Students' "salary" in studies are credits which they earn by completing – and only by completing – courses. On the other hand, they are gathering knowledge and skills for the rest of life. A student has an optimisation problem whether just to pass the courses or invest more time for learning. This can be described as students' deep, surface, and strategic approaches of learning (Hemminki et al. 2013, 10).

The goal of the group work for each student can be different. If the intended goal of the course is that students learn new roles in a project, then students must be guided to step out from the comfort zone and try new roles that they

have not earlier done. Otherwise, it sounds reasonable that the roles are assigned based on the prior expertise of the students. (Biggs & Tang 2011, 255.) Students' focus is primarily in the assessment of the course and grades ("salary") and only after that in the required learning activities which finally produce learning outcomes. Why work more if one gets credits and a better grade easier?

Active learning in groups helps student to reflect, e.g. "Have I got this right?" (Biggs & Tang 2011, 69), and the social pressure motivates studying (Arnold et al. 2010, 501). Project groups can produce final results which individuals could not do alone. Nevertheless, students may not necessary like working in groups due to earlier bad experiences. Many doubts are understandable, since working together requires other people, and it brings coordination, motivation and intellectual costs compared to working alone (Helkama et al. 1998, 255; Kerr & Tindale 2004; Using Group Projects Effectively). A teacher should be ready to justify group methods, or the student may be instructed to read group work guides. Teamwork, as any other transferable skill, falls in the category "learning to learn" which should be highly emphasised in higher education. For example, instead of reading through sixth or seventh theory or formula, one can practice a learning skill which is transferable to other courses.

It is clear that the expertise in working in groups, and especially teaching these skills requires a lot. However, as a teacher it is calming to read Colbeck et al. (2000, 77-78) who interviewed students from the groups in which the teacher's guiding role was low or missing. Students assured that they had learnt and applied teamwork skills using their own self-reflection even if teachers' interventions could improve the overall interdependence in a group. Repo-Kaarento (2010, 43) reminds that sometimes it is good that students may choose how to work, in a group or alone.

6.2.4 Cooperative learning

There are good books for teaching and using group work in the learning and teaching situations. As a conclusion, a commonly acknowledged framework called cooperative learning is introduced. A novice teacher may choose this framework to start with. Johnson et al. (1998, 30) describe the cooperative learning by five key elements. The instructor should design the group task so that each element is visible:

1. Positive interdependence. The task requires each member of the group to succeed and the group can help in it (win-win). Interdependence can be encouraged by common goals, rewards, roles, and resources.
2. Individual accountability. Each member of the group is responsible on doing his/her own job.
3. Face-to-face interaction. Interaction promotes learning inside the group.
4. Members are facilitated with interpersonal skills. There should be time reserved for learning skills of leadership, decision-making, trust-building, communication, and conflict-management.
5. Group processing and reflection. The group should ponder how it works and how it could work better.

The cooperative learning is often compared to competitive learning. Repo-Kaarento (2010, 48) lists several rules that distinguish cooperative learning from competitive one in Table 2. Johnson & Johnson (2002, 98) note that combining cooperative, competitive, and individualistic learning may be supplementary under certain conditions.

Table 2. Cooperative learning vs competitive learning.

Cooperative learning	**Competitive learning**
Help others to succeed.	Do only your own jobs.
Be responsible to yourself and the group.	Take care only of yourself.
Take responsibility of group outcomes.	Do not care what others do.
Tell others and listen to what they say.	Do not advice others.
Ask for other opinions. Ask for help.	Do not ask for help.
Discuss and let others take part.	Pay attention only to the teacher.
Participate in common action and take eye contact also to other students.	Look at the teacher only.
Be active and speak.	Be quiet.

6.3 Findings of teamwork skills at Aalto University

We made some expert interviews and read different kind of teaching materials to capture the real cases of teaching of teamwork skills at Aalto University. At the same time, we were collecting a network of expert teachers who could join together and share their experiences.

At Aalto University, the teachers and resources come from departments. Students study in the degree programmes which utilise resources of departments. This is a feature in the matrix organisation that pops up frequently in the teaching development discussions. It is not always clear who is the educational leader, a chair of department with the budget or a programme leader with no budget but all students. The curricula of degree programmes are designed and confirmed yearly by the academic committees of the schools. The learning outcomes contain content-specific knowledge, professional skills, and transferable skills (e.g., Teknistieteellisen kandidaattiohjelman opinto-opas 2014). The course description by teacher-in-charge contains the learning outcomes, working methods and tools of assessment, and the actual lecturers can typically choose suitable teaching methods. Teachers are considered fairly autonomous in good and bad. The bachelor degree reform in 2013 and the master degree reform in 2015 have forced faculty to talk over the department borders. The extensive self-evaluation of teaching activities in 2010-2011 (Learning Together 2011) will be followed by a national audition in 2015-2016.

6.3.1 Initiatives at Aalto University and degree programme levels

The bachelor programme reform started in 2011. New students entered the renewed programmes in 2013 and the process is still going on. The reform included lots of planning and designing so that the new system is more student-

centred according to the Aalto University strategy. Kettula and Ylitalo (2013) defined three levels of competence in learning teamwork knowledge and skills in the student's perspective. This categorisation may help in the evaluation of mastering teamwork skills.

New initiatives have been taken to enhance learning-centred culture at Aalto University during the last years. Aalto Design Factory (ADF), Aalto Ventures Program (AVP), and Aaltonaut study programme are examples of communities which are all in a way or another connected to entrepreneurship, a key element in the Aalto University strategy. Entrepreneurs tend to focus on "working together". The courses in these programmes typically facilitate teamwork, and many teachers possess expertise in teaching teamwork.

There has been active curriculum development at School of Engineering with the project O4 which aims to be an assisting study guide for a student (Hyötynen 2013). During the development work teachers at the degree programmes have fulfilled a huge matrix where they have assigned identified professional skills into the courses. A computer system applying this data has been built to serve students (Opiskelijaa ohjaava opinto-opas 2014). A student may, for instance, choose a major of energy technology as a competence area, and then browse what kind of courses he/she has to complete to receive the competence. In the same example, choosing teamwork as a skill lists over 20 courses containing some aspects of teamwork skills. In this way, teachers have made it explicit in which courses teamwork skills are to be taught.

There are also renewals in more conservative areas. Since the last bachelor degree reform 2013, the physics teaching at the first study year in the major of applied physics was turned from traditional lecture-driven courses to project-based courses. In addition, peer evaluation of students' solutions has been adopted as a standard way of self-assessment in the renewed basic mathematics courses. It should be noticed that a change in the basic mathematics course affects learning experiences of all students at the university. Another example of a mandatory bachelor level project-based capstone course, SCI Studio, started in autumn 2014. Students from different major subjects formed heterogeneous groups to tackle real-world projects.

Pedagogical training of teachers helps in taking new methods into use. It also helps in discussing educational issues with the same terminology. First pedagogical programmes at Helsinki University of Technology (Aalto University) started in late 1990's. Now hundreds of teachers have completed at least the introduction course in university pedagogy (5 ECTS).

6.3.2 Teachers' experiences at Aalto University

In the course level, it is clear that teaching teamwork skills requires both theory and practise. The course "Individual in groups" contains a group work where a group watches a movie in which a group of people plays a central role. Students have to analyse the video in the group perspective. They also make self-reflection of their own action. An expert teacher also confirmed that one has to be strict with the methods. Students are required to do the project plan with a timetable individually and as a group. Students need to keep track on the hours in

the document. Instructions need to be step by step, and the progress has to be monitored during the course, not only after it.

Another expert teacher pointed out that it should be clear what the real target of individuals is in a project work. If the meaning is that students learn new things, then the roles have to be changed. The straight implication is that much more time has to be reserved and there has to be interdependence in the roles, i.e., an expert teaching a novice for the specific role.

Group forming is an important phase and each teacher has favourites how to do that. An expert teacher in a software project course asks background information. Students having most experiences ("best ones") are first scattered to different teams. The teacher has found that the most relevant attribute for composing groups is whether a student is "a morning or evening person". An optimal size for a group is typically 3-5 in the literature but one expert says to prefer the group size of 10 because members have to really decide how to organise the work. It is also useful to know the grade a student is aiming at. Most teachers seem to let students choose their group mates. In case of random assignment to groups, some teachers claim that in the real world you cannot choose partners whereas other teachers say that you can.

Teachers claim that the term "group work" is often used for the activities which are actually not belonging to the interdependent group work. A typical case is a course assignment to be done in groups. Students often split it to parts, the parts are written individually, and the parts are glued together without any common synthesis. This can be seen as an efficient way of fulfilling the attainments. A remedy could be that the assignment requires interdependence. If the interdependence is not needed, teacher implicitely accepts splitting and glueing. Teachers also acknowledge that students are often left alone "in the dark" (Colbeck et al. 2000), as one teacher writes: "*Students are thrown to deep water without instructions of group forming, setting targets, possible challenges and benefits they could get out of group work.*"

6.3.3 Student aspects at Aalto University

Finally, the student and his/her learning is the most important thing in the higher education. The course feedback for first-year students at Aalto University School of Science revealed that students tend to like working in groups. The string "ryhmätyö" ("group work") was mentioned in 206 answers (7.4 %) to a question, what was good and helped your learning. The same number for a question, what did not help you, was 81 (2.9 %), and most comments concerned some practical issues to be developed. However, there are also contrary opinions, as one anonymous student from a physics project course puts it: "*I learnt that putting effort in projects is useless because my work is lost when others do not do anything. I learnt that the project proceeds when each member works independently instead of working together.*" It seems that the student has not gained enough positive interdependence in the work but still acknowledges the individual accountability. Most probably, the group forming and organisation may have failed. One has to remember that the group performance is highly complex task to measure (see Kerr & Tindale 2004).

There is evidence of long-term effect of using problem-based learning (PBL) in the degree programme of Information Networks. Students get used to the PBL method using seven steps (Repo-Kaarento 2010, 82) right from the first semester on. The students have even named their guild room as OLOhuone ("LIVING room", the Finnish abbreviation OLO stands for PBL).

The task of organising teamwork skills cumulatively in several courses in the curriculum could be flipped around. One expert teacher was interested of the idea that students fill in the "transferable skills' licence card" during their studies. The card, or portfolio, could contain empty rows for different transferable skills and subskills, and the student reflects on his/her learning activities if the requirements for the skills have been met. In this way, the skills and the way they are to be learnt are explicitly expressed for a student even if they are not assigned in the written curriculum.

6.4 Discussion and conclusions

Mastering teamwork skills and teaching them is not an easy task. We have made a literature review and discussed with experts who are teaching teamwork skills at Aalto University. There are lots of good books available and material in the Internet. Knowing the theory is only the first part of mastering teamwork skills. Based on experiences, advice and tacit "feeling", teachers plan the group activities in the course, guide and monitor the groups, and provide help for resolving conflicts. The quality assurance circle closes by evaluating the process and creating development acts for the next course. An efficient use of groups requires a lot of work from the teacher. Pedagogical training and instructions may help individual teachers to find new tools to make their teaching more efficient.

Critical points can also be raised. Some students claim that there is already too much teamwork. Too often the teamwork task is not designed properly and students get negative experiences during their work. Teachers have different thoughts what is the allowable amount of cooperation, and student cannot know that in advance. One can still argue whether working in groups makes learning deeper or more effective. And finally, does the teamwork in studies contribute teamwork skills in the work life or are they two different worlds?

The results of the study are the following:

1. Methodologically, it is obvious to analyse teamwork skills in three levels or angles: curriculum and educational leaders, course and teachers, and student view.
2. It became evident that there are lots of hidden knowledge and expertise at Aalto. We have found now a few experts. Experts can be found by a key search in the curricula. (However, deriving a complete curriculum as one spreadsheet requires some work.)
3. Writing a study report of teaching of teamwork skills helps learning of teamwork skills mostly from the theoretical point of view. Practical rehearsal is needed. The same applies to students in a teamwork course.
4. An action list is given in the following subsection.

We hope that this project is one step towards a student-centred learning environment. Teachers are working pretty alone and independently but the changes and degree reforms have forced teachers and educational leaders to interact over the borders. It would be beneficial to continue development activities by sharing ideas and experiences in different disciplines. Are hard and soft sciences so different that the implementation of transferable skills is also different in the teaching/learning activities? We may also ask, just as Barkley et al. (2014, xiii), why teachers have not adopted collaborative methods in teaching even if there is evidence that students learn better in that way.

If one and only one key phrase is allowed to describe good teamwork skills, it is "positive interdependence". Following the description in the framework of co-operative leaning, the term gives guidance to a teacher to construct the group activities so that students need each other. On the other hand, students work harder for the group to give and receive positive force to accomplish the task in the group.

6.4.1 Action points

Based on the literature review, expert interviews and the synthesis, the following actions points are raised. They are not listed in any particular order but the reader has to weight them.

For the curriculum design and educational leaders:

- From top down – check the learning outcomes of the degree. Are the transferable skills explicitely written? Assign teamwork skills to courses. Check that the skills are trained cumulatively from student's first year to graduation. An interesting framework of curriculum design, O4, exists at Aalto University School of Engineering (see Hyötynen 2013).
- From bottom up – utilise experienced teachers to teach teamwork skills. Provide Aalto courses (3 ECTS) of transferable skills for students. For instance, the negotiation skills have been marked with a largest gap between the work life need and the teaching (see Malo 2014). Invest on an umbrella project on transferable skills (see Yhdessä parempaa pedagogiikkaa 2013). Challenge your teachers to join.
- Encourage the faculty to take pedagogical studies. Encourage teachers to try new methods in the spirit of "freedom to succeed" (or "freedom to fail"). Admit that reserving time for skills may cost a slice from the content knowledge but it really pays off.
- Practising teamwork skills may have positive side effects. There is potential to foster the interaction between Finnish and non-Finnish master level students (see Arkoudis et al. 2013).

For pedagogical units:

- Collect books and other materials on teaching transferable skills, and bring them available for teachers. Advertise the collection regularly. Force participants of the pedagogical courses to get acquainted with the collection.

- Set up an annual feedback workshop where teaching/learning of transferable skills is evaluated.
- Collect a network of experts who have both theoretical and practical knowledge on teaching of teamwork skills. Most probably you find experts in the capstone courses.
- Call for a research project analysing students' feedback data. The data contains lots of open answers which may include students' experiences on transferable skills.
- Call for a research project analysing degree programme descriptions and learning outcomes of the courses.
- Provide tools for self-evaluation of one's level in transferable skills.
- Provide tools for "driving licence of transferable skills" using CDIO Syllabus (Crawley et al. 2010, 257-268), teamwork expertise levels (Kettula & Ylitalo 2013) and O4 (Opiskelijaa ohjaava opinto-opas).

For stakeholders, enterprises:

- Keep alive active discussion which kind of skills are needed.
- Provide student groups real projects in the win-win context.

For the course implementation and teachers:

- Get familiar with a framework of cooperative learning. Create teamwork which requires "positive interdependence" (see Johnson et al. 1998).
- Reserve time for teaching skills, reserve time to students for learning them, and assess it in your course. Do not advertise too much transferable skills in your class if you do not really demand it. Implement in a fashion of constructive alignment (Biggs & Tang 2011).
- Take part in pedagogical training.

For students:

- Some courses on teamwork skills already exist. Take part in and learn more. Check also the list of Aalto courses (3 ECTS). Ask for a specific course in transferable skills.
- From bottom up – use a "driving licence of transferable skills" to make explicit what you know and can.

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7. Negotiation skills

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7.1 Background: The need

The ability to negotiate and to find a common ground is vital in the business and industrial world as individuals, companies and other organizations do not operate in isolation but work with, and are dependent on each other. Hence, negotiation defined as "a form a decision making in which two or more parties talk with one another in an effort to resolve their opposing interests" (Lewicki, Barry, & Saunders 2010: 3) is in the core of the organizational and individual cooperation. Such terms as 'partnerships' and 'alliances', for instance, generally refer to firm-level collaboration. Yet, these relationships do not originate autonomously but typically require capable boundary-persons to initiate firm-level collaboration. The role of these persons is to build trust but also to negotiate and agree on financial (e.g., terms of payment), technical (e.g., R&D) or contractual (e.g., IPR issues) aspects of the collaboration. On an individual level, in turn, negotiations occur even more frequently. These negotiations are often embedded into the daily work routines and concern such issues as e.g., salaries, schedules, and working methods. And if we adopt the broad view on negotiation, it occurs on a daily basis in every spheres of life (e.g., work, family, friends) and thus the capability to negotiate is vital to navigate within these spheres (Fisher & Ury 1991).

Yet, the current curricula of the Aalto University do not seem to offer too much teaching on negotiation skills. Take the surveys of the Finnish Association of Business School Graduates (SEFE) as illustrative evidence. Among its other activities, SEFE conducts surveys on the career development of business school graduates. According to these studies, the ability to conduct negotiations are ranked as important but missing skills of business students both among themselves (Haapasalo, 2009; Raita, 2011) as well as among corporate employers (Sefe, 2011). Similarly, the career services of Aalto School of Business conduct surveys on their alumni's on a three-year interval. One of the main objectives of these surveys is to assess how well the Master's degree and its learning outcomes (knowledge and skills) are in line with the needs of the business and corporate world. According to the findings several skills, such as presentation skills and problem-solving capabilities, are well-covered in the Master's level courses. Yet, one of the few shortcomings of the program seems to be the lack of negotiation

training. In fact, negotiation skills appear *repeatedly* in these studies as extremely important but not well taught skills within the program (Söderholm & Makkonen, 2011; Makkonen, 2013). Similar findings occur among the members Academic Engineer and Architects in Finland (TEK). Recent engineer graduates recognize that negotiations skills are important (3.5 / 5), and that there is a gap between their degree deliverables and their industrial profile (Harmaala, 2012). Moreover, more than 80 per cent of the engineers with more extensive work experience state that they need develop their competence in terms of conducting negotiations (TEK 2013)

The strategy of Aalto University and the competence matrix of e.g. the Master's program of the Department of Marketing highlight such skills and capabilities as team-working capabilities and presentation and communications skills. Negotiation skills, in turn, seem to be nearly absent from the current curricula. Consider Aalto School of Business as an example. The word search for 'negotiation' generates several hits on language courses (i.e., German, French, Spanish, Russian, and Swedish), which focus mainly on cultural aspects of negotiations, but only four hits on other courses: 'Legal Aspects of Business Contracts', 'Principles of Selling and Sales Psychology', and 'Negotiation Analytics', and 'Introduction to New Venture Creation Process'. By contrast, the same search in the School of Science and School of Engineering generates zero hits. In brief, it seems to be safe to argue that despite their importance, negotiation skills are not taught sufficiently in-depth within Aalto University. In fact, the two courses which focus solely on teaching negotiation skills within Aalto are the 'Aalto Course on Negotiation and Dispute Resolution' which was taught in spring 2014 but which has not secured its continuance, and the optional 'Negotiation Analytics' within the Department of Information and Service Economy (School of Business).

The aim of the present study is to review the current practices and methods used in teaching negotiation skills and to complement the review with the insight of experienced teachers and educational professional in the field of negotiation. Moreover, the attempt is to provide recommendations on how to develop negotiation teaching in Aalto. This chapter proceeds as follows. The next section covers the literature review on how to teach negotiation skills. The synthesis section consolidates the key insight from expert interviews with literature, and delivers practical knowledge for educators on how to integrate negotiation skills into content teaching.

7.2 On negotiation skills

While some argue that negotiation represents a skill 'which cannot be taught, they can only be learned' (Pedler, 1978: 21) we concur with the view that negotiation is a skill that can be taught. Thus our premise in terms of the important aspect of intended learning outcomes (i.e. what the students can actually do after the course) is that the goal is to improve the skill of negotiation (McAdoo & Manwaring, 2009), and not merely to increase the understanding on negotiation theory (cf. Wheeler, 2006).

Yet, we also acknowledge that negotiation is not a single skill but a complex collection of skills including aspects of strategizing, advocacy, communication, persuasion, and cognitive packaging and repackaging information (Lewicki, 1997). Indeed, negotiation as a skill can be unpacked into several components as reported in Table 7.1.

Component of negotiation skill	Sources
Understanding the **issue** and the **context** under dispute	Lewicki, 1997; Fortgang, 2000; Salacuse, 2010
Self-reflection in order to calibrate confidence in oneself as well as develop understanding of others.	Holtom & Kenworthy-U'Ren, 2006
Defining or **framing** the issue in an appropriate manner	Lewicki, 1997
Redefining or **reframing** the issue if such a redefinition might lead to a better outcome	Lewicki, 1997; McAdoo & Manwaring 2009, 2009
Constructing a line of argument to support what one wants out of a negotiation	Lewicki, 1997
Persuasively organizing and **presenting** this **line of argument**	Lewicki, 1997
Active listening to gain information and to understand areas of agreement and disagreement without revealing one's own view	Lewicki, 1997; McAdoo & Manwaring 2009, 2009; Patton, 2009
Creatively **brainstorming** and inventing **options** to bridge these areas of disagreement	Lewicki, 1997
Articulating and recording **a final agreement**	Lewicki, 1997

Table 7.1: Components of negotiation skill

Patton (2009) further proposes that different negotiation skills (e.g., active listening) can be broken down into micro-skills (e.g., paraphrasing meaning, asking questions, demonstrating empathy), and that by practicing such skills repeatedly they become stored one's 'action repertoire' (Patton, 2009: 490; Williams, Farmer & Manwaring, 2008). Similarly, Salacuse (2010) highlights that preparation (e.g., gaining the knowledge, information, and insights to effectively negotiate with another party) is a vital negotiation skill.

The majority of the literature promotes the skills vital for conducting win-win negotiations i.e., coming up with a collaborative and mutually beneficial agreement. Yet, if a collaborative negotiator meets a competitive hard bargainer, the latter is more likely to obtain a better result (Kirgis, 2012; Lewicki, Hiam & Olander, 1996). Hence, Smolinski and Kesting (2013) suggest that for a negotiator the most effective skill is "the ability to recognize the characteristics of the negotiation situation and the attitude of the counterpart and to efficiently apply the methods and techniques that optimize performance in such settings" (Smolinski & Kesting, 2013: 367).

7.3 Literature review on teaching negotiation skills?

McAdoo and Manwaring (2009) distinguish two types of negotiation learning: (1) high-road conceptual learning i.e., the ability to abstract, understand, and apply general principles to different contexts, and (2) low-road skill training i.e.,

triggering of reflexive responses in sufficiently similar learning conditions without the need for deliberate application of abstract principles. Due to such complexity, teaching negotiation requires that learning occurs on several levels. These include the common levels of memory (i.e. student can recognize, identify and describe the purpose of e.g., a negotiation tool), understanding (i.e., student understands how and why the tool works) and application (i.e., student can use the given tool in a limited number of situations) but also, and more importantly the level of transfer. On this transfer-level or 'low-road skill' learning (McAdoo & Manwaring, 2009) a student can select and use or even develop an appropriate tool for wide range of distinctive or unique situations (Patton, 2009; Pedler, 1978).

From the perspective of a teacher, transfer-level learning connotes that there are no generally accepted "right" answers, that learning objectives are more difficult to set, and that methods are more complex to structure. Moreover, recent studies suggest that teaching negotiation is especially challenging as students have negotiated many times before they expose to negotiation teaching (Loewenstein & Thompson, 2000; Patton, 2009). As a consequence their negotiation behaviors tend to be difficult to change as it 'is driven by habits, assumptions and associations they have acquired throughout their lifetimes' (Wheeler 2006: 189). To cope with such challenges, there seems to be almost a unanimous agreement among academia that negotiation requires experiential learning (Fortgang, 2000; Lewicki, 1986; Lewicki, 1997; Pedler, 1978; Salacuse, 2010). Experiential learning, i.e. helping learners to learn from their own experience, is a cyclical process including four elements: (1) formation of abstract concepts and generalizations (typically via theory), (2) testing implications of concepts in new situations, (3) concrete experiences, and (4) reflection (Kolb, 1974; Lewicki, 1986). As this model is widely accepted among negotiation pedagogy, this report adopts the four stages of the model as a structure for reporting the key findings regarding teaching practices of negotiation.

7.3.1 Introduction of theory and basic concepts of negotiation

Introducing the theoretical basis of negotiation is essential so that the students understand the basic concepts and tools of negotiation (Fortgang, 2000) and as well as know when in terms of theory how, and why they are used (McAdoo & Manwaring 2009, 2009). Theory-wise, however, negotiation courses seem to be divided into two disciplines. The first discipline is based on cognitive, rational, economics/game theory view (Loewenstein & Thompson, 2000; Bazerman & Neale, 1992; Murnighan, 1991; Raiffa, 1982), which is mainly based on competitive, adversarial distributive model of negotiation (Fortgang, 2000). The second discipline, in turn, is based on social and psychological view (Lewicki et al., 1993; 1994; Pruitt & Rubin, 1986; Rubin, Pruitt & Kim 1994), which emphasizes skills-centered workshop approach (Loewenstein & Thompson, 2000). Yet, many of the current courses on negotiation tend to be a blend of the two.

The relevant question is, then, which theoretical concepts should be included into the curriculum. We adopt the view of the more recent studies which propose that many courses incorporate ideas, frameworks and concepts from both

disciplines (Fortgang, 2000; Loewenstein & Thompson, 2000; Shell, 2001). Hence, by synthesizing the key studies in the field we propose the following topics as the key theoretical learning objectives for negotiation pedagogy.

- to understand the conflict theory; basic dynamics of interpersonal and intergroup conflict
- to understand the game theory
- to acquire an overview on strategy and tactics of competitive, distributive, or win-lose bargaining
- to acquire an overview of the strategy and tactics of cooperative, integrative, principled, or win-win negotiation
- to understand individual and contextual factors that enrich and complicate negotiations such as cognitive processes, differences in negotiation personality, the role of power, persuasion processes, negotiation within and between groups, gender, culture
- to understand the differences of interpersonal vs. intergroup and multiparty negotiations
- to acquire an overview of the procedures for moving deadlocked negotiations; conflict resolution; third parties
- ethics
- to understand on different bargaining styles (accommodating, compromising, avoiding, collaborating, competing)

As to teaching methods, the prior studies suggest that this conceptual knowledge can be efficiently delivered via traditional knowledge-transfer methods such as lectures, seminars, books, handouts, pre-readings (Pedler, 1978). The relevant literature for educators includes, for example, the classic book of *Getting To Yes* by Fischer and Ury (1981) as well as *The Art and Science of Negotiation* by Raiffa (1982).

7.3.2 Testing implications of concepts in new situations

While the stage of introducing theory (discussed above) as well as the stages of action and reflection (discussed below) are fairly straightforward, this stage of experiential learning has received a conceptual flux among the academics in the field. It has been referred to 'personal goal setting' in which students set objectives for their personal behavior as a negotiator (Lewicki, 1997), or is has been labeled as 'demonstrations' (e.g., modeling and numerous examples), which help to translate theory to practice and to imagine adaptations and modifications to models (McAdoo & Manwaring, 2009). We adopt the latter view in which the aim is to translate introduced theory and concepts into practice. Hence, the aim is to practice and experiment new negotiation behaviors by imitating in safe environment (typically classroom) and prepare the students for the actual negotiation. The difference between this testing stage and the following action stage is that negotiation settings and behavioral models are predetermined by the teacher.

Methods of such experiments include e.g., analyzing real-life case studies or traditional/online videos (Sebenius 2011); experimenting and practicing prescribed behaviors of a particular model by e.g. imitating negotiations on videos (Pedler, 1978), and planning and preparing for simulations or real-world experiences to understand the required knowledge (Pedler, 1978).

7.3.3 Practicing negotiation skills via concrete experiences

Perhaps the most distinctive element of experiential learning is that students are exposed to concrete experiences. The key findings on such methods are summarized in Table 7.2.

Method	Description	Authors
Simulation games/role play exercises	The instructor exposes students to a wide range of negotiation contexts via hands-on exercises where students can experiment different negotiation skills and strategies, and then compare and reflect their results with classmates (who often achieve different outcomes)	McAdoo & Manwaring 2009; Fortgang, 2000
Reality-based simulation games	As above, but the simulations are based on pseudo-reality i.e., real-life facts and conflicts in which the participants have situational familiarity. Yet, the actual simulations are fictional and typically focus only on solving a defined portion of the entire conflict.	Ebner & Efron, 2005
Visitors – traditional approach	Practitioner do a one-off visits into the class room telling anecdotes relating their real-world negotiation experiences as well as some general 'how to do it' advice.	Groth & Glevoll, 2007
Real-life cases with two visitors	Students are given a real case as a pre-reading including two visitors/parties (e.g. buyer and seller). The class is divided into two groups according to these parties. Both groups (buyer and seller) prepare questions based on the case for the actual buyers and sellers who did the real-life agreement. So, the visitors do not provide ready-made story but insight on how to prepare for negotiation. Thereafter both groups develop ideas on win-win scenarios. On the final session, the win-win ideas of both groups are compared between each other and the actual real-life agreement.	Groth & Glevoll, 2007
Digital video recordings + reflection journals	Students use webcams with laptops to record their negotiation exercises. Then students view these recordings and reflect their performance in a journal before uploading the videos and journals to a network folder. Teacher then reviews the journals and parts (tabbed) of the videos and provides individual written feedback.	Williams, Farmer & Manwaring, 2008
International negotiation competitions	Teams of students (2-5) and a coach attend international negotiation competitions to see how their negotiation styles work in a highly competitive context that imitates the real negotiations including such emotions as e.g., satisfaction, disappointment, frustration, and anger. General instructions are distributed in advance to allow proper preparation. Competitions include several rounds in which different cases or role-plays are negotiated or mediated. During these rounds teams are ranked or steadily eliminated. The two finalists negotiate in the final round.	Smolinski & Kesting, 2013
Negotiating for money	Students agree on and pay a player's fee at the beginning of the negotiation course so each negotiation exercise has an actual dollar value at risk.	Volkema, 2007

Real-life projects	A semester-long, hands-on consulting project for e.g. local community, which allows the students to experience and reflect upon a series of negotiations related to project completion.	Kenworthy-U'Ren, 2003
Online methods	A negotiation course taught completely online. Negotiation exercises can be done via e.g., teleconferencing. Yet, the most important forum is the discussion board where both students and the teacher post their comments, reflect their experiences and share information. Ideal number of students is between six and ten. Online teaching requires more, not less work compared to traditional courses. Similarly, careful planning and preparation in advance is essential.	Weiss, 2005

Table 7.2: Teaching methods of negotiation skills

All in all, many elements of negotiation teaching can be done off-class (e.g., pre-readings, preparation for simulations) thus saving valuable in-class time for the most productive activities such as negotiations exercises and debriefings. Relatedly, prior scholars suggest that, in fact, any conflict situation which arises in the class room (starting, finishing times, agenda, deadlines) may be amenable to a negotiated situation (Pedler, 1978; Lewicki, 1997).

7.3.4 Reflection and feedback on negotiation exercises

To improve learning, action is followed by reflection and feedback. Reflection is vital for highlighting key conceptual and theoretical points (McAdoo & Manwaring 2009), for enhancing analogical reasoning (i.e., comparing and contrasting experiences with similar dynamics but different contexts; Patton 2009), for providing students opportunities to note deficiencies in their own behavior or process; and for finding new ways to negotiate (McAdoo & Manwaring, 2009; Williams, Farmer & Manwaring, 2008). Reflection can occur on two levels. On one hand, students can reflect on behavior of others via e.g. case studies or videos. On the other hand, students can and should reflect their own negotiation behavior (i.e. self-reflection).

Closely related to reflection, feedback is important too. Indeed, prior studies suggest that negotiation teachers need to reserve sufficient amount of time for debriefing (McAdoo & Manwaring, 2009) as well as provide multiple opportunities and sources (peers, self, instructor) for ongoing feedback (McAdoo & Manwaring, 2009; Williams, Farmer & Manwaring, 2008). Table 7.3 summarizes the key methods for enhancing reflection and providing feedback.

Reflection	Written assignments as essays and journals on negotiation exercises	McAdoo & Manwaring 2009; Lewicki 1997
	In-class debriefings of negotiation exercises	Lewicki 1997; Pedler, 1978
	Videotaped negotiations: watch + reflection analysis applying theories or setting goals for future behavior	Williams, Farmer & Manwaring, 2008
Feedback	Private discussions on video-recorded exercises	Williams, Farmer & Manwaring, 2008
	Written comments on blogs	McAdoo & Manwaring, 2009
	Unstructured feedback (e.g. informal feedback with peers, tutors, and teacher)	McAdoo & Manwaring, 2009

	Structured feedback (e.g. learning interaction analysis and using checklists to reinforce a cycle of teach-analyze-re-teach)	McAdoo & Manwaring, 2009

Table 7.3: Reflection and feedback in negotiation training

Finally, the prior studies on negotiation pedagogy does not propose that above described stages of experiential learning (formation of abstract concepts and generalizations, testing implications of concepts in new situations, concrete experiences, and reflection) should occur in a specific order. On the contrary, a course can start with a theoretical introduction, a case analysis, a gentle simulation or with a reflection of students existing assumptions on negotiation (Pedler, 1978). Moreover, a course can include one or several cycles of experiential learning (Lewicki, 1986).

7.3.5 Evaluation and grading

One of the most challenging aspects in teaching negotiation skills refers to evaluation i.e., how to assess whether the students are more efficient negotiators after the course (Lewicki, 1997; Patton, 2009). Outcome-based evaluation tends to be the most dominant way to evaluate negotiation learning. Examples of such methods include simulations that (1) allow various settlement packages to be scored, (2) based on number of points won, (3) based on who got the best package, and based on (4) who invented the most integrative solution. One challenge of such outcome-based evaluation is that those students who negotiate well already tend to win while those who do not have prior experience and/or natural capabilities (e.g. active emphatic listening) tend to lose and as consequence dislike such basis for grading.

International negotiation competitions take a broader view on evaluation. In such competitions the student teams are typically evaluated in three areas: 1: Preparation (e.g., analysis, explication of interests, strategy), 2: Process (e.g., effective team work; listening skills, empathy, the ability move toward a collaborative outcome without giving up ones commercial interest and needs; communication and negotiation skills, the ability to collaborate in order to find a solution, flexibility), and 3: Outcome (e.g., value creation, value claiming drafting of joint contract, self-analysis, ethical behavior) (Smolinski & Kesting, 2013).

Finally and on a more general level, there tend to be lack of strong scientific evidence on the effectiveness in negotiation training. In other words, is negotiation training effective? Does it pay off? (Lewicki, 1997; Patton, 2009). Few studies have been done in this area providing promising results (see Movius 2008 for a review), yet more studies are needed in this area.

7.4 Expert interviews: How to teach negotiation skills?

To enrich our literature view, we conducted expert interviews in the field of negotiation training (see Appendix). The objective of these interviews was to ac-

quire up-dated, novel, and in-depth view on negotiation pedagogy. The interviews tackled such issues as the core components of negotiations skills, key literature, efficient teaching methods, and evaluation of negotiation learning. For the sake of brevity, the key findings of the interviews are not elaborated separately. Instead, the following section presents the synthesis in which the literature review is complemented with the key insights from the interviews.

7.5 Synthesis: How to integrate negotiation skills into content teaching?

Most of the reviewed literature on negotiation pedagogy is on how to teach negotiation in a course, which is fully dedicated for such purpose. Yet, the aim of this study is to examine how to integrate negotiation training into content courses or as Salacuse (2010: 189) puts it 'teaching negotiation in the shadow of substance'. The synthesis, too, follows the familiar logic of experiential learning.

7.5.1 Introduction of theory and basic concepts of negotiation

The interviews, the literature review as well as a brief benchmark comparison among top-universities[6] highlight the need for a basic course on negotiation. The basics of negotiation (theory, frameworks, terminology) tend to be too broad to be integrated, as such, into other content courses without drastic content adjustments and work-load recalculations of the 'host-courses'. Hence, the first implication of this study is the necessity of a negotiation course. As one interviewee put it: "Without basic course they [i.e. the students] start to do wrong things" and that "it's like doing calculus without algebra, it's just not gonna work".

If such basic-level course exists, the further development of negotiation skills might be more effective by integrating advanced negotiation training into content courses (Nykänen & Tynjälä, 2012). This dual structure (i.e., basic course on negotiation + integrated negotiation training) would have one major benefit; namely it would ensure that after the students have learned the basics skills of negotiation, such skills would be developed further within the professional contexts of the students (e.g., architecture, business, technology development, media).

As to the taught skills, the interviewed negotiation experts agreed with the components of negotiation skill presented the Table 1 but especially emphasized the skill of active listening. Moreover, one interviewee highlighted the role of preparation in negotiation as follows: "It's all about preparation, negotiations are won by preparation." In addition, all the interviewees and the literature (Wheeler 2006) emphasize the need to break-away from the common assumptions, mindsets and attitudes of negotiation being win-lose game in which the more aggressive and/or powerful always outperforms the other party. Finally, the interviewees noted that the basic theoretical content is well-covered by the dominant book in the field i.e., Getting To Yes by Fischer and Ury (1981).

[6] Three out of 20 top-universities in world did *not* have a specific course on negotiation.

While one of the findings of the study is that in-depth negotiation training preferably requires a specific course, teachers can teach the negotiation skills by integrating some aspects of negotiation skills into their content teaching. In these cases, the basic concepts can be introduced e.g., via highly recommended self-reading, which is not, however, integrated into to the workload of the course. As to more concrete teaching methods, the remaining part of this chapter describes how to integrate negotiation training into content teaching.

7.5.2 Testing implications of concepts in new situations

Echoing the notion of the context emphasized above, any forms of testing implications mentioned in the literature view (i.e., analyzing real-life case studies or videos, experimenting and practicing prescribed behaviors of a particular model, and planning and preparing for simulations or real-world experiences) can be used in content teaching simply by selecting the real-life cases or videos from the specific context of the course. So, for business students, for instance, the students would analyze e.g., a buyer-seller negotiation case whereas architect students would focus on analyzing or preparing for a real-life negotiation case between e.g., a construction company and the local community.

7.5.3 Practicing negotiation skills via concrete experiences

Many of the methods which expose students to concrete negotiation experiences can also be used within content teaching. The core idea is, again, to apply the methods in the specific context of the course (e.g., architecture, business, environment, technology development, media). The key methods for such integration are synthetized and elaborated in Table 7.4.

Method	Description	Notes and sources for teachers
Context-specific simulation exercises	The instructor selects hands-on negotiation simulation within the context of the course.	Simulation exercises can be bought from e.g., http://www.pon.harvard.edu/
Real-life cases with two visitors	Students are given a real case as a pre-reading including two visitors/parties within the context of the course (e.g., architecture, business, technology development, media, etc.). This approach would allow the visitors also to pass on in-depth and tacit knowledge of the specific context (e.g., professional conventions and procedures, industry characteristics and policies).	Acquiring committed visitors from both sides of the negotiation is an effort. Trustworthy relationships between parties (and between the teacher) are a necessity as the parties are asked to open up and elaborate their negotiation history.
Digital video/Skype recordings	Students use webcams with laptops or even Skype to conduct and record their negotiation exercises. While recognizing the value of face-to-face exercises, the benefit is that some of the off-class negoti-	Skype-recording software, see e.g., http://www.evaer.com/

	ation exercises can be done remotely and thus more conveniently.	
Real-life projects in the specific context	A hands-on consulting/development project for in the specific context, which allows the students to experience and reflect upon a series of negotiations related to project completion.	Even the establishment of a project can belong to the responsibilities of the students as it engages them to prepare and negotiate with the other stakeholders of the project (e.g. purpose, scope).

Table 7.4: The key teaching methods of negotiation within content teaching

This context-specify would yield three pedagogic benefits. First, the negotiation exercises become more focused on the students' professional domains thus preparing them well for their professional endeavors. Second and relatedly, recognizing the direct link to their future careers, the motivation of the students to participate and put effort on such concrete exercises will most probably increase. Third, context-specific exercises and projects can be used an additional medium in delivering content. A simulation exercise on business negotiations in high-tech industry, for instance, will also provide knowledge on the characteristics of such industry. However, this approach will have also one potential limitation; it may limit analogical reasoning i.e., a powerful learning method as it allows students to compare and contrast experiences with similar dynamics but different contexts (McAdoo and Manwaring, 2009; Movius, 2008; Patton, 2009).

7.5.4 Reflection and feedback on negotiation exercises

The feedback and reflection methods summarized the Table 3 are also valid in negotiation training, which is integrated into other courses. The main extension from the interviews was that the reflection needs always to be applied into specific situation from the past (e.g., personal or professional experience, simulation), not just reflection on e.g., what kinds of thoughts and ideas the concepts or frameworks of negotiation brought in one's mind. To provide convenient hands-on tools for teachers, Table 7.5 sums up helpful activating questions, which trigger reflection and thus advance learning.

Question	***Pedagogical purpose***
How do you feel?	*To provide participants with the opportunity to vent their feelings and emotions.*
What happened?	*To collect data that will encourage participants to recall their experiences and discover similarities, differences and patterns*
What did you learn?	*To encourage participants to come up with generalizations and to test them.*
How does this relate to the real world?	*To relate the simulation game experiences to real-world experiences.*
What if?	*To encourage the participants to extrapolate from their experiences in multiple or altered contexts.*
What next?	*To encourage action planning based on the insights from the activity.*

What surprised you in the negotiation? Why do you think that was surprising?	*To prompt learners to uncover their pre-negotiation assumptions, what happened when those assumptions were disconfirmed, and what this means for future learning patterns.*
What was difficult or challenging about this negotiation? Why did you find that difficult?	*To give learners the opportunity to notice cognitive, emotional, or other intrapersonal barriers.*
What do you find puzzling about this activity/exercise/discussion? Why is it puzzling? What would help you better understand it?	*To help students hone in on where their understanding might be fuzzy, and what they might do about it.*
What metaphors or images come to mind when you think about negotiation or value creation or preparation, etc.?	*To heighten students' awareness of their own mental models or schemas and how this supports or hinders their learning process.*
What similarities do you notice between this exercise and the negotiations in which you typically engage?	*To enhance analogical thinking*

Table 7.5: Reflection questions in negotiation exercises (McAdoo & Manwaring 2009: 210-211)

7.5.5 Evaluation and grading

All the interviewees challenged outcome-based evaluation. As one expert put it: "How do you grade a good simulation player from another? It's [about] participation and it's [about] creatively thinking ways to get to mutually beneficial agreement." In its simplest form the negotiation exercises and assignments within other content courses can be assessed on a pass/fail basis. Another interviewee emphasized the role of safe atmosphere, which allows the students to throw themselves into new learning situations without the fear of constant monitoring and evaluation. Hence, if negotiation exercises are evaluated, the scale of evaluation should be rough enough to build and maintain such atmosphere.

As a synthesis from the interviews and from the prior literature, this study proposes that evaluation should include such aspects as the level of participation (e.g., how well students' are prepared for the negotiation exercises, how active students' are in the class room and in the exercises) and the depth and level of self-reflection (e.g., the depth students apply the new knowledge and skills) along the course. Whatever basis of evaluation is used, however, the importance of prompt feedback on exercises and reflection assignments is crucial.

7.6 Conclusions and implications

The aim of this chapter was to examine and synthesize how to integrate negotiation skills into content teaching. For teachers, this chapter provides valuable, concise and hands-on input on such integration as well as on negotiation pedagogy in general. Especially the tables sum up the key findings of the negotiation pedagogy literature as well as suggest further avenues on how to incorporate

negotiation skills into their content courses. The second implication for teachers is that to improve their negotiation pedagogy, the teachers themselves may benefit from professional negotiation training

For university decision-makers the implications are twofold. First, securing the continuity of the basic-level negotiation training within Aalto University is a necessity. Second, allocating resources for faculty training is vital so the teachers are equipped to integrate advanced and context-specific negotiation training into their courses.

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8. Sustainable Development

Elina Kähkönen

8.1 Background: The need

The drive towards sustainable development (SD) is commonly accepted as a major paradigm in the today's world. It was defined by the United Nations Bruntland committee (UN 1987) as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This broad definition covers environmental, social, and economic sustainability. The emergence of SD themes into media and decision making since its emergence in the 1960s can be observed, e.g., in the establishment of World Wildlife Fund in 1961 and Greenpeace in 1971, in the foundation of United States Environmental Protection Agency (US EPA) in 1970, and more recently in the enforcement of the first worldwide environmental agreement—the Montreal protocol in 1987 (WWF 2014, Greenpeace 2014, US EPA 2014, UN 2014).

During the last few decades, SD has been increasingly integrated into our society: i) as numerous national, international and global regulations, which guide us towards the protection of the environment and human health and towards sustainable usage of global resources; ii) as an ever-growing number of voluntary guidance for corporations and consumers on how to improve sustainable development, e.g., Global Reporting Initiative (GRI) in 1997, Dow Jones Sustainability Indices (DJSI) in 1999, EU Eco label scheme in 2000, and ISO 14001 Environmental Management Systems in 2004 (EC 2000, GRI 2014, DJSI 2014, ISO 2004); and iii) as the emergence of new technologies and research in the fields of material and resource efficiency, in waste and emissions treatment, and in methods for evaluating the life cycle impact of products on the environment, health, and resources.

Here, Universities have evidently conducted a great deal of research and education. Yet, the current levels of sustainability education in the curricula can arguably be viewed as inadequate. The role of higher education in this regard is crucial due to the fact that the vast majority of the decision makers in the public and private sectors have a degree from a higher education institution (Lindgren et al 2006). Accordingly, the role of universities in the case of SD is not only to respond to working life requirements, but to help develop the working life and

society to meet the requirements of SD. To improve the situation in SD education, several initiatives such as Tuft Clean, the HE 21 Project, and most recently the Decade of Education for Sustainable Development by UNESCO, have been launch (Velazquez et al. 2005). Furthermore, publications in the field of sustainability education aim at sharing the findings on teaching methods (e.g. Seiner and Posch 2006), strategies for building a study program (e.g. Wiek et al. 2011) and exploring the ways of integrating SD into the curricula of universities (e.g. Moore 2005, Lindgren et al. 2006). Despite this activity and support, the main emphasis in these and other numerous reports focuses on pointing out the bottlenecks in SD integration instead of the success stories.

With regards to the former, the major bottlenecks for integrating SD into higher education are seen in the following areas: the complex organisation of universities (Lindgren et al. 2006), the decentralised decision making on course contents (Ferres-Balas et al. 2008), unclear definitions and subsequent challenges in measurement (Stainer and Bosch 2006), and the traditional focus on narrow research areas. Strikingly, this last challenge was identified frequently and the movement towards trans- and interdisciplinary education was promoted as a viable route towards improved SD integration among a wide assortment of references (e.g. Stephens et al 2008, Steiner and Posch 2006, Lindgren et al. 2006, Ferres-Balas et al. 2008, Moore 2006, van Ginkel 2010, and Faedeeva 2010). In reference to the aforementioned challenge, the interdisciplinarity of Aalto University offers an exceptional opportunity to become the leading example among those universities aiming to integrate SD into their curricula and courses.

As with many other universities worldwide, Aalto University is committed to the RIO 20+ goals (Teeri 2012). Here, the first stated target aims to integrate sustainability and responsibility into all teaching and research by 2015. Specific defined activities have already been accomplished, such as the establishment of the Creative Sustainability Master's programme, Sustainable Global Technologies Educational Modules and Aalto Energy Efficiency Research programme (Aalto 2014). On the one hand, the course offering for SD is available. On the other hand however, it is not clear how the SD goals are present in the degree requirements. Altogether, it is not evident how the progress towards the goal – to integrate SD in all teaching – is being measured. The aim of the present study is to evaluate the current status of teaching in the field of SD in Aalto University and, if relevant, to propose actions to fulfil the promise given in the strategy statement.

8.2 Methods and approaches

The Research Questions (RQ) of the present study are as follows:

RQ1: How much and in which ways is SD currently present in teaching and in degree requirements at Aalto University? Which organisations in Aalto University are responsible for providing the teaching in the field of SD? For whom is the teaching offered?

RQ2: What kinds of actions, if any, are needed to reach the Aalto University goal by 2015 to include SD in all the teaching [and research]? Which are the major challenges in the integration and how are these challenges dealt with by the teachers in the current courses in which SD is integrated?

RQ1: SD goals in teaching in Aalto University: by whom to whom?

The RQ1 is tackled by screening the Aalto University course offering to find those courses in which SD topics are covered. The whole course offering of the Oodi database was transferred to an excel format and filtered by key words—"sustainab", "responsib" and "environment" and screened by the topics—energy, waste, biomaterials, and water. In the case of the Aalto School of Art, Design and Architecture (Aalto ARTS), the courses were studied by screening the course titles in the Noppa database as the courses (apart from the architecture courses) were absent from the Oodi databases. In the Noppa database the search function is applicable only for titles and not for the topics and learning goals. Hence, only those courses, which include SD in their title, were studied more thoroughly in order to identify which organisations are responsible for providing the SD-related teaching, and at which stage of the studies is the SD related teaching offered. The same data was utilised to find and categorise different ways of integrating SD in teaching.

The other route to elaborate on the RQ1 was to study the criteria for the Masters' level graduates (Tutkintosääntö) in schools of Aalto University. The approach at this point was to find if and how the strategic target was realised here.

RQ2: Which are the prospects and contradictions in further SD integration?

The thematic interviews were conducted with the three teachers whose courses have SD integrated therein (see questions in Appendix 1). The attempt here was to find commonalities in how the teachers see the present teaching situation in Aalto University (when compared to the strategic goals) and what kinds of actions they consider to be applicable in order to increase SD in Aalto University teaching (if necessary).

8.3 Results

8.3.1 RQ1: SD courses in Aalto University: by whom to whom?

Based on the course information, the SD topics are integrated in 4% (138 courses) of all the 3700 Aalto University courses. The division between the different schools of Aalto University is as follows: the School of Art, Design and Architecture (Aalto ARTS) with 24 courses, the School of Business (Aalto BIZ) with 17 courses, the School of Chemical Technology (Aalto CHEM) with 23 courses, the School of Electrical Engineering (Aalto ELEC) with 6 courses, the

School of Engineering (Aalto ENG) with 56 courses, and the School of Science (Aalto SCI) with 9 courses (Figure 1).

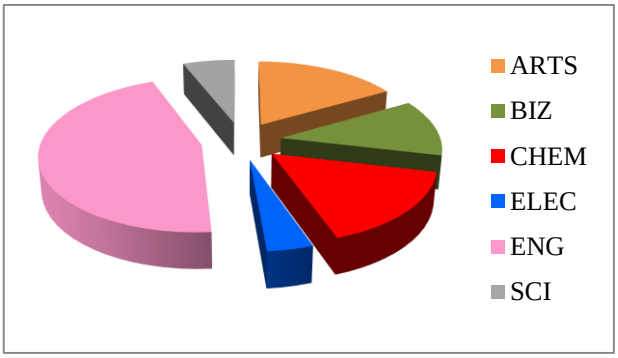

Figure 8.1. The distribution of the AU courses dealing with SD topics between the AU schools.
ARTS = Aalto ARTS
BIZ= Aalto BIZ
CHEM= Aalto CHEM
ELEC = Aalto ELEC
ENG = Aalto ENG
SCI = Aalto SCI

Aalto ENG is the leading school in offering courses with integrated SD. A notable share of the offering deals with energy, real estate and civil engineering and construction technologies. Aalto CHEM's courses are very much related to environmental technologies and to renewable raw materials. Not surprisingly, the major focus of the SD courses in Aalto BIZ lies in corporate responsibility and business ethics. Furthermore, Aalto BIZ together with Aalto ARTS and Aalto ENG manage the Master's program, Creative Sustainability (CS), which is dedicated to a multidisciplinary approach on SD topics. In addition to the CS course offering, the majority of the SD courses in Aalto ARTS are from the field of architecture.

A majority (53 courses) of the SD courses is offered at the master's level while the bachelor's level incorporates 21 courses. The difference between these is that the courses at the master's level set common prerequisites for the students while the bachelor's level courses are more at the general level and within the reach of most students. Notably, the information on the students for whom the course is intended was largely missing. The courses offered solely for the doctoral students were quite few (7 courses).

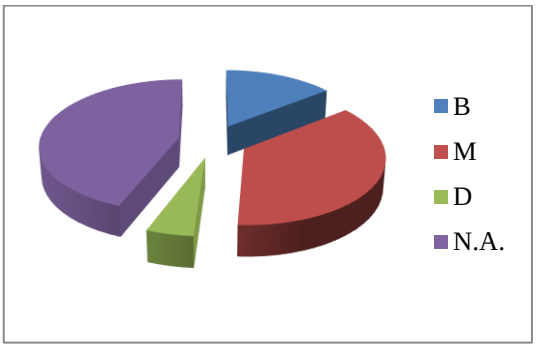

Figure 8.2. The distribution of the course offering between the different study levels.

B = Bachelor's level
M = Master's level
D = Doctoral level
N.A. = information not available

The course data was incomplete especially with regards to Aalto ARTS. Thus the share of SD courses could increase notably with complete information on the learning goals and topics handled in the 1100 Aalto ARTS courses. The other source of inconsistency in the data stems from the calculation of teaching based on the number of courses and not the amount of credits. However, within the scope of the present study the indications may be considered to provide a sufficient estimate of the present status.

The criteria for the Masters' degree requirement (tutkintosääntö) in the different schools of Aalto University are currently under review. However, according to currently available versions, 3 out of 6 specifications set the "ability to comprehend the solutions from technology, society and environmental point of view" as a requirement while the others did not set similar requirements (Aalto ARTS 2014, Aalto BIZ 2005, Aalto CHEM, Aalto ELEC 2013, 2011, Aalto ENG 2011, Aalto SCI 2013). Evidently, this requirement is strongly connected to SD education. When comparing the degree specifications to the course offering, there is no clear correlation between these. AaltoCHEM and AaltoENG, which state the b.m. requirement, also offer a notable amount of SD teaching (figure 1). Conversely, AaltoELEC, which also has the similar requirements in the degree specifications, offers the least SD teaching of all the schools.

The three ways of integrating SD into the main course topics were thus identified (Table 1). Based on the information in the Oodi database pertaining to the titles, topics and learning goals, the following categories are presented. The categories are displayed here in the order of prevalence from the most common to least common.

1) SD perspectives are integrated in the courses with the main focus in the disciplinary topics in which the SD is included in different ways extent. Firstly, a course on a certain technology, product design or business area may include the environmental impacts of such a product, technology or service in the course learning goals. An example here is Ship machinery systems –a course at which the learning goals include "*the environmental impacts of the [ship] machinery*". Secondly, the inclusion of SD topics may take place in the general description of the current working and business environment. One example here is the course Management and International Business in which the topics of the course include *"strategy work, international business, sustainability management and HR"*. Thirdly, SD may be actively integrated in a course as examples, exercises or project topics even if the evident connection between SD and the course topic are not present. For instance in the course ICT Innovation Summer School, the "*societally relevant thematic area (for example, Health and Wellbeing, Smart Energy Systems)*" are incorporated into the focus of the business development process. Fourthly, the SD topics in these courses are not directly included in the course, but the connection between the course topics to SD is actively presented. Here the example is the course Functional Oxide Materials in which the relevance of SD in the course context is pointed out in the learning goals: "[…] *insights into the synthesis and properties of various important functional oxide materials employed in new sustainable energy technologies* […]". Altogether 59 courses fall into this category.

2) The SD approach or implications on a disciplinary topic are drawn into the center of the course. Typically, the courses are entitled with the terms "sustainability", "environmental"or "responsible". Also the learning goals and topics handled in the courses are clearly focused on SD. An example here is the Corporate Responsibility in Global Economy

course, in which the learning objective is "*to look at the challenges and dimensions of corporate responsibility in global economy and enable the students to reflect their own values on the course topics. During the course, the students will learn to define and to discuss the key concepts related to corporate responsibility and be able to connect practical issues with the theories dealt with in the course*". 45 courses are in the category.

3) The disciplinary topic falls in the field of SD so inherently SD topics cannot be fully avoided. Certain disciplinary topics, such as energy technology or renewable materials are central questions related to SD. Hence, teaching the basics of these topics falls in the field of SD even if the terms such as "sustainability" or "environment" are not mentioned. The example here is the course, Waste to energy, in which neither the title nor leaning goals or topics include the key words and yet the learning goals are crucial from the SD point of view: "*[…] the students will be able to: understand, and distinguish what are the options of waste recycling; describe, recognise and classify the option of energy recovery from waste; know, recognise, understand and describe different processes for thermal treatments of solid waste; identify and describe various techniques of waste incineration plant; apply and solve process calculation in waste to energy plants; […].*" 30 courses were defined to belong to this group.

Table 8.1. Summary of the way of integrating SD in disciplinary teaching

Category	Relation between SD and disciplinary topic	Number of the courses
1	SD integrated in disciplinary topic • inclusion of the environmental impacts of the discussed technology in the course • inclusion of the social responsibility in the description of the current business environment • inclusion of SD topics in the exercises or the assignments at the course • connecting the course topic to SD questions	59
2	SD is the central approach in the disciplinary topic in the course	45
3	Disciplinary topic is central to SD and may not be discussed without touching on SD topics	30

8.3.2 RQ2: Interview results: Need and suggestions for further development of the SD integration

Note: In the following chapters, the numbers (1-3) in the brackets tell how many interviewees repeated the same comment.

Background of the interviews

All of the interviewed teachers had over a decade (average 16 years) of teaching experience in Aalto University (previously Helsinki University of Technology, School of Art and Design). The taught courses (and one program) are of different ages (1, 4 and >10 years). The reasoning for the establishment of the course or program in the question varied. The establishment of the program focusing on SD topics was strongly supported by Aalto University management as it combined the two strategic goals: to enhance interdisciplinary teaching and SD teaching in Aalto University (1). The other two courses were established from the disciplinary needs (2).

Evaluation of the current status

Adequacy of the current SD offering was considered differently. 4% of the course offering sounds very low (1) and over 100 courses adequate (1). Here, the critics were presented on the information sources used as the learning goals of the Aalto ARTS were missing and according to the interviewee the SD integration there is wide (1). On the other hand, the current expertise on SD was considered inadequate (1) or as being at risk to be reduced (1).

The interviewees emphasised different learning goals for the Aalto University students from the SD point of view. Skills for logical and fact-based thinking (1) and the basic knowledge of SD topics for all, and a deeper understanding of one's own discipline SD topics (1) were highlighted. The widest definition for the learning goals included curiosity to discover the necessary information, courage to use the information and solutions according to one's own conscience and the ability to communicate the facts for a layman. (1).

Proposals on the development

All the teachers considered, evidently, that SD topics are important and the proposals for further integration were presented as follows.

- An obligatory course for all Aalto University students for presenting the SD topics (1).
- Increasing the category 1 type of integration by different ways of motivating the teachers for integrating SD into their courses was presented. Taking SD into account in teaching was seen as important by all (3) and compared to the general requirements for being a "good teacher" (1). Related to the last comparison, similar kinds of encouragement for incorporating SD as part of the teaching was suggested as a means for improving the teaching skills: SD integration in courses could be taken as a topic in pedagogical training (1). Furthermore, awards similar to "Teacher of the year" could be considered as a tool to gain visibility for the topic (1).
- Sharing the information about SD courses and other course offerings in Aalto University was seen as a tool to better utilise the present offering and to get wider perspectives on the courses (2).

Development needs and bottelnecks

The interviewed teachers viewed the needs and challenges very differently related to further integration of SD in teaching. Currently, a clear gap in the skills of the present graduates was seen in the ability to communicate to laymen and to see the technological solutions in a societal context (1). The future thread of a decrease even in the necessary skills – logical and fact-based thinking – was suspected due to the reduction of basic mathematics and physics teaching (mainly engineers were considered here) (1). On the other hand, the excessive basic studies was regarded as filling the courses to the point where no space was left over for wider topics or development of one's own thinking – not to mention own ethics (1). Furthermore, the overuse of the term "sustainability" with vague definitions was seen as reducing interest in the topic and to the teaching accordingly (1). Related to this, the teachers' own attitudes on the topic were seen as a risk in case they colored the teaching too much towards academic quality teaching (1). Two of the interviewees advised against writing – not to mention requiring - SD or similar key words in all the course learning goals.

8.4 Conclusions

In light of the present evaluation on course offerings, degree specifications and the expert interviews, it is safe to state that SD is currently not integrated in all the teaching in Aalto University. The potential number of courses into which SD can still be integrated ranges in the thousands in Aalto University. Furthermore, there is no comprehensive target for graduates from Aalto University regarding expertise related to SD in terms of skills, knowledge and attitude. Notably, half of the schools in Aalto University set requirements related to SD while the other half does not.

Individual teachers are in a key role in integrating SD topics (as well as any other topic) in their own disciplinary teaching. The teachers define very autonomously the learning goals and the topics of the course. This independence has advantages and disadvantages. On the one hand, a motivated teacher can immediately integrate SD into her/his course. On the other hand, the tools to impact a teacher's course decisions are limited in a decentralised organisation like Aalto University. This organisational challenge is recognised as a bottleneck also in literature (Ferres-Balas et al. 2008). The proposed tools to further integrate SD in the existing courses were among the similar kinds of encouragements as for improving teaching in general—the offering of pedagogical courses with tools for SD integration and awarding the SD teaching activities. This proposal is in concurrence with the general outline presented by Lindgren et al. (2006) to focus on the recognised barriers preventing integration of SD into the courses. The aforementioned focused pedagogical training would enable the sharing of views between teachers and, hence, an increase in the teaching perspectives of an individual teacher. This would prevent the risk of excessively colored teaching. Another proposal to introduce a new SD focused course for all

the students in Aalto University would offer a uniform base for the students on SD topics. Ideally, the development of a common course for all Aalto University students may function as a platform to gather the teachers of Aalto University in the SD field to share their knowledge and approaches. Simultaneously, the SD course development would gain visibility for the topic in the whole university and may encourage other new teachers to integrate the topic in their teaching. However, the introduction of a new obligatory course for all the students should be decided by the university management.

Several ways of integrating SD in teaching were pointed out in the present curricula of Aalto University. The SD topic may be included in the learning goals, e.g., "student is able to evaluate the environmental impacts of a product/ equipment/technology", in the topics related to the current working and business environment, and in exercises or assignments or at least as a description of the connection between SD and the disciplinary topic. In considering integration of SD into disciplinary courses and also in new courses with SD as the central approach, it would be a great asset if the knowledge on the current SD related course offering was easily available. Moreover, some general advice for the development of SD education would be to verify that the students have sufficient time and tools to develop their thinking during the courses.

In conclusion, the suggested actions to further integrate SD into Aalto teaching focus on activities around teaching and the teachers themselves. This differs from the recommendation of Moore (2006) to impregnate all the university decision making and activities with SD. However, it may be argued that the recommendations presented here offer concrete advice for proceeding into the desired direction. Altogether, Aalto University is currently in a unique position to challenge other universities by realising the strategy statements on SD teaching. The interdisciplinary setup in combination with its relatively young age creates a window of opportunity for the implementation of new ideas.

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Interview questions

Table 8.2. Interview questions.

Question
Background
What is your background as a teacher in AU?
How long have you taught at the course [name of the course]?
How have you developed the course [name of the course]?
What is your background in teaching on [SD topic of the course in question]?
Present SD integration in the course
How important you consider the role of the SD at your course?
What was the initiative for integrating [SD topic of the course in question]?
What was the main initiative to establish the course(s) on SD?
What kinds of actions were needed?
What kinds of challenges were met?
Future goals
What kinds of expertise should the graduates from AU have concerning the SD topics?
Which way of integrating SD in the AU teaching you consider as the most efficient? How should this be enhanced?
Do you see some lacks; topics that are missing, expertise that is not among the learning goals, in the present SD teaching in AU?
Is AU strategy goal fulfilled now? If not, what actions should be taken?

9. Discussion and recommendations

Our attempt in the study was to define, in which ways transferable working life skills are currently integrated and how they should be integrated in teaching at Aalto University. We conclude our findings and give recommendations to our stakeholders.

9.1 Transferable skills in teaching at Aalto University

Transferable skills that prepare the students for entering professional life are mentioned as one of the key goals in the strategic objectives of teaching in Aalto University (Aalto Handbook v. 1.1. 10.4.2014). However, this goal needs to be elaborated further at the university-level and included in the specifications of quality in teaching at the school-level. The aim of our study was to focus on seven transferable skills vital in working life (i.e., self-knowledge, reflective learning, critical thinking, creativity, teamwork, negotiation, and sustainable development) and examine (1) how they are currently taught in Aalto University, and, more importantly, (2) how such skills can be integrated into content-based teaching. The seven chapters of this report provide detailed pedagogical elaboration on these specific skills. Their key findings can be summarised as follows:

- Learning goals for transferable skills need to be made visible in educational planning and teaching quality assurance.
- Support is needed for teachers in teaching transferable skills and integrating them in content-based courses.
- We acknowledge that transferable skills are not only working life skills but they support learning as well.

9.1.1 Current state at Aalto University

Based on the present findings, it may be stated that all of the seven studied transferable skills are integrated into teaching in Aalto University to some extent. However, the adequacy of the teaching compared to the need of the named skills varies from skill to skill and from student to student. Furthermore, the development of such skills is not necessarily planned in the curricula of the study programmes, nor is the progress in learning the skills followed up. In practise, the integration of any of the studied skills in teaching rests greatly on shoulders of the teacher responsible for a course. This kind of autonomy in

teaching is fundamental in university teaching. However, it poses challenges for the implementation of university strategies, study program learning goals, or degree requirements concerning these skills. Evidently, the statements in the strategy of Aalto University identify such skills as creativity, critical thinking, and sustainable development. Despite this, these skills are neither included in all of the degree requirements, nor in the courses of the study programmes. Moreover, it appears that the only assessments conducted regarding the adequacy of the skills learning are those conducted in working life after graduation. Here, it remains unclear how the results of the yearly published evaluations are linked to curricula development or further to course development. Yet, this may be seen as an elementary component in the evaluation of the quality of teaching in courses, programmes and at the university level.

9.1.2 Integration to content-based teaching

This study provoked us to consider the relationship between transferable skills and content-based skills such as design, engineering, programming, and accounting. Teaching transferable skills may be superficially seen as a competitor with the traditional content-based teaching, as the students' workload within each curriculum and program is limited. While some of the essays state that teaching certain skills would benefit from additional skill-specific courses, we are not proposing that such resource allocation is mandatory, or even the only possibility. On the contrary, we suggest that teaching such skills can be integrated into content teaching with relatively modest investments (see Sec. 9.1 for recommendations). Indeed, as the transferable skills will be eventually applied in the professional context (e.g., conducting teamwork in engineering), it is only natural that their teaching is also integrated closely to the content-based teaching. In most cases this means that their teaching is a part of content courses, though separate courses may sometimes be appropriate.

More importantly, many of the examined skills are valuable even before the students enter working life as such skills can be applied and utilised during the studies, and in fact, are essential to deep-oriented learning. Consider self-knowledge, reflective learning, critical thinking, and creativity as examples of such skills. Consequently, we argue that teaching and developing these skills contributes directly to the learning effectiveness and outcomes of content-based teaching. Similarly, teamwork skills contribute to collective learning practices and, as such, benefit the learning of core content and knowledge. In brief, we argue that *integrating transferable skills into content-based teaching is an efficient method for universities to prepare their students for the working life but also to improve the effectiveness of content-based teaching*.

9.1.3 Skills at different temporal phases in the curriculum

It is also worth considering the phasing of transferable skills into the student's path from the freshmen year to the undergraduate and graduate levels. While we acknowledge the context-specific variety among disciplines and pro-

grammes, we propose the following as a rough guideline. To start with, we suggest that the three intra-personal skills of *self-knowledge, reflective learning,* and *critical thinking* should be emphasised in a fairly early stage, as all of them are foundational in nature and thus enhance the overall learning processes. In a similar vein, we argue that *teamwork skills* should be introduced fairly early and also developed throughout the learning path.

Creativity, in turn, probably requires a different approach. Teaching creativity should start in early stage of studies by integrating problem finding and open problems into the building of the knowledge base, and later freedom for creativity should be increased and more risks taken in project works. Of course in the arts, creativity plays an emphasised role throughout the studies. Similarly, we argue that *negotiation skills* should be emphasized at a later stage of the studies because negotiation training tends to be more effective when the students have already acquired some experience on negotiations through teamwork projects and exercises. Finally, we propose that skills related to *sustainable development* are key factors in modern society and that to equip the students with a sustainability mindset, sustainable development should be present throughout the students' path.

9.1.4 Interdependencies between skills

As one conclusion of the study we present the relations of the skills to each other and elaborate on how the skills relate to the learning of content-based knowledge. These relations may be taken into account when planning integration in a curriculum.

By synthesising our findings we found that these seven skills do not develop and operate in isolation, but rather several interdependencies exist between them, as shown in Fig. 9.1.

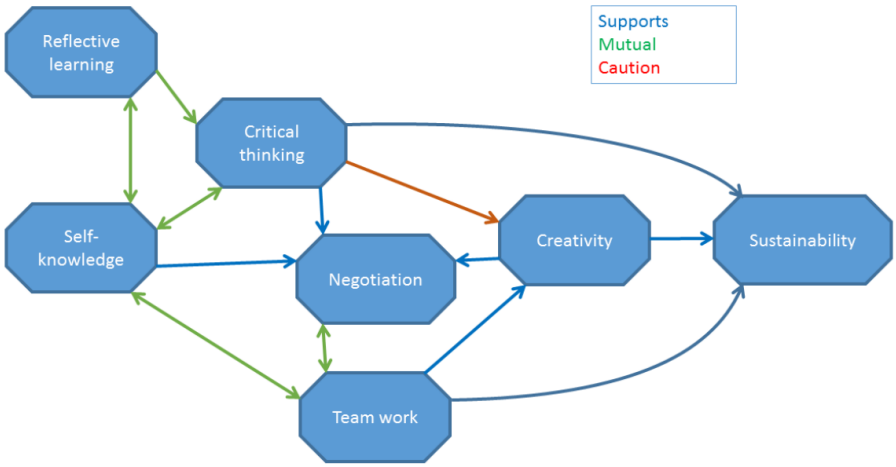

Figure 9.1: Interdependencies between the skills of self-knowledge, reflective learning, critical thinking, creativity, teamwork, negotiation, and sustainability.

As Fig. 9.1 illustrates, reflective learning, self-knowledge, and critical thinking build on and support each other; being aware of one's own characteristics and competencies (i.e., self-knowledge) improves reflective learning, whereas the

process of reflective learning reveals deeper insight into one's identity. In the same way, critical thinking both benefits from and is supported by self-knowledge and reflective learning as a critical mindset is essential for deep-oriented, reflective learning, and for the diagnostic assessment of one's core areas of improvement. Self-knowledge and teamwork also have a mutually supporting relationship, as operating in teams is helpful in assessing one's strengths and weaknesses, while being a self-knowledgeable team member is essential for identifying and agreeing on the roles within a team.

Furthermore, teamwork and negotiation skills are mutually related as teamwork, by definition, requires negotiations between the team members. Negotiation skills also benefit from self-knowledge for calibrating confidence, and from creativity for inventing win-win options to bridge areas of disagreement. Creativity benefits from teamwork as it makes it possible to combine and co-develop ideas. However, not just any ideas qualify but they need to be evaluated using critical thinking; yet creativity can also be hampered with too intensive criticism, or other cases where critical-thinking skills are applied in a deconstructive way. Finally, working for sustainability requires collaboration (i.e. teamwork) but also critical thinking to challenge and question the status quo as well creativity to offer novel solutions.

9.2 Recommendations

All in all, it is the vital but collective role of the university, program managers and teachers to ensure that the required transferable skills are covered in the curricula and programmes. While the university and its management set the overall strategy and allocate resources based on that strategy, it is mainly the program managers and teachers together who need to decide what skills should be integrated into the learning objectives, and then how they should be taught and evaluated. The recommendations below capture our core message to stakeholders.

9.2.1 Strategy and curriculum

1. Teaching transferable skills should be part of curriculum planning. These skills should be mentioned in general descriptions of curricula. Those who lead the planning of Aalto curricula should take transferable skills strongly in their agenda.
2. In the curriculum planning the association of each transferable skill to each course should be made clear and explicit. The planning should also ensure that the transferable skills are trained cumulatively from student's first year to graduation.
3. To identify the needs for transferable skills, an active discussion with stakeholders and enterprises should be maintained. To evaluate the current status in teaching, a project analysing students' feedback data should be launched; the data contains lots of open answers which may include students' experiences on transferable skills.
4. The teaching quality management should tie the feedback from the stakeholders (point 3) into the curriculum and to course planning (point 1 and 2)

5. Aalto's new learning spaces should support learning of transferable skills. It is clear that interactive skills like teamwork, creativity, and negotiation skills are not supported by traditional big lecture halls designated for a teacher-centred approach. More teaching and learning should occur in flexible spaces that could be alternated for experimentation.

9.2.2 Integrating transferable skills into content teaching

1. Provide student groups real projects in collaboration with stakeholders such as private enterprises. When arranged with care, projects provide excellent possibilities to learn a variety of transferable skills integrated into tasks that are close to working life.
2. Multi-disciplinary studies, such as project work on multidisciplinary teams, should be part of every student's learning experience. Projects provide excellent possibilities to integrate transferable skills teaching. Diverse teams support learning of interactive skills of teamwork, negotiation, and creativity. They also support self-knowledge and confidence as each student gets to show expertise to students from other backgrounds.
3. Regarding content courses, it is not necessary to overly promote transferable skills in a class if the teacher does not teach it, and assess it in a particular course.

9.2.3 Teachers' knowledge and skills on teaching transferable skills

1. Teachers should actively develop themselves in teaching transferable skills, both by studying the underlying theories and searching for suitable teaching methods. Educational leaders should encourage teachers to try new methods in the spirit of "freedom to succeed". Reserving time for transferable skills may reduce time for the content knowledge, but it does pay dividends in overall learning.
2. Instructions should be compiled to improve coherence of studying methods and transferable skills teaching methods throughout Aalto. A good example of this is how to write learning journals. Instructions in different courses should be coherent to help students write good learning journals and assist teachers in giving advice on how to write them.
3. The quality teaching of transferable skills should be rewarded.
4. Aalto teachers' pedagogical training should include a module on "How to teach transferable skills". This could be a separate course, a workshop, or a part of some pedagogical course. This would not only benefit the students via better teaching but also teachers themselves in their working life at the university.
5. Aalto should facilitate peer support between the teachers, who have experience and who need experience on teaching the transferable skill. Especially, the degree brograms could take leading role in organising informal meeting to share the experiences and challenges here e.g. by organising support clinic activities or regular networking opportunities
6. A collection of books and other materials about transferable skills should be made easily available and well known to teachers.

9.2.4 Student perspective - how to show mastery of transferable skills

1. Tools for self-evaluation of one's level in transferable skills should be provided as a part of "Opiskelutaidot" information in INTO.

2. Students could have a transferable skills “driving license” that is based on the learning portfolio collected during studies. In the portfolio they could register what transferable skills they have learned during each course in their study program.
3. The portfolio may be used also when applying for the summer jobs as an evidence on working life skills.
4. Aalto could provide students a button or reflector with text such as "License to study" or "License to learn". That could be given to the first year students after they have passed the “Johdatus opiskeluun” course. This could be made a desirable product with appropriate encouragement.
5. Set up a feedback mechanism where teaching/learning of transferable skills is evaluated. This calls for clear definition of learning goals concerning each skill at a course and including these goals in the evaluation of learning out comes and/or in course feedback system.

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Eerikki Mäki, D.Sc. (Tech.) works at the Department of Industrial Engineering and Management. He has over 10 years teaching experience on courses related to knowledge and competence management, research methodology and development of human potential.

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Joni Tammi, Ph.D., Director of Aalto University Metsähovi Radio Observatory, teaches astronomy and space science at Aalto ELEC. His favourite teaching course is the Aalto course "Astronomical View of the World", where he seeks to promote multi-disciplinary teaching and transferable trans-disciplinary skills.

Kalle Palomäki, D.Sc. (Tech.) is an Academy Research Fellow, docent in information and computer science, and a research team leader. He has teaching responsibilities for example in seminars and for course “Fundamentals of Information Technology”. He is currently planning a new bachelor’s course on “Applied Digital Signal Processing”.

Jukka Parviainen, M.Sc. (Tech.) works in the project Students’ care and support where he works with new engineering students at Aalto SCI. His teaching experience covers topics in machine learning and signal processing.

Jukka Partanen, D.Sc. (Econ.) is a postdoc researcher at the Department of Marketing (School of Business). His current teaching responsibilities include Entrepreneurial Marketing, Business Marketing Management, and Capstone course for Marketing

Elina Kähkönen, D.Sc. (Tech.) is teacher-in-charge in the interdisciplinary minor program Aaltonaut. She is responsible for the course “Contemporary topics on product liability” on sustainable development in product development.

Interviewed experts

Kalevi Ekman is a professor and holds a chair of Machine Design at the Department of Engineering Design and Production in School of Engineering. He is also recognised as the founder of the Aalto Design Factory, an experimental platform aiming to support interdisciplinary and international co-creation between parties interested in any aspects of design and development. Design factory is among Aalto's flagship projects to build a cross-disciplinary learning enviroments and also connections between businesses and education.

Stina Giesecke is a senior university lecturer at the Department of Industrial Engineering and Management in School of Science. She has been the responsible coordinator of the bachelor degree reform (2011-2013) at the School of Science. She is teaching the course "Individual in groups" for 300 students.

Daniel Graff is a doctoral student in Department of Management Studies in School of Business. He holds a long and international career and presently works for International Design, Business and Management programme (IDBM). He is teacher-in-charge of the course "Creative Teamwork" in the IDBM programme.

Harri Hakula is a senior university lecturer at the Department of Mathematics and Systems Analysis in School of Science. He teaches courses on mathematics and has been active, among other things, in development of bachelor education.

Huimin Hurry is a program manager and an education professional in the Aalto Executive Education. She is the responsible manager of the Strategic Influencing and Negotiation program, a practical and interactive program which focuses on improving negotiation skills of experienced business professionals.

Jonna Kangasoja is the CEO of Akordi Oy, a company which offers negotiation, conflict management, and mediation services and training. Jonna received her negotiation training at the Program on Negotiation at Harvard Law School, and at MIT. She also teaches negotiation course on Negotiation and Dispute Resolution within Aalto University as well as conducts research is this area.

Jaakko Korhonen is a doctoral student in the Department of Industrial Engineering and Management in School of Science. Jaakko has been working as a

course assistant in the course Filosofia ja systeemiajattelu (Philosophy and Systems Thinking) for several years.

Tiina Laurila is the program director in Creative Sustainability Masters' programme in School of Arts.

Eero Miettinen is a professor in the Department to Collaborative and Industrial Design at the School of Art and Design. He has been teaching design ethics for a long time.

Jukka Mäkelä is an adjunct professor in the Department of Management in School of Business. He has done research on corporate social responsibility and business ethics.

Keijo Nikoskinen is a professor and the dean of the School of Electrical Engineering. Besides his research interests in electromagnetics he has a deep intrests in developing education in his field. He was previously appointed as the vice dean of the School of Electrical Engineering – a position in which he was the head of education in his school.

Göte Nyman is professor emeritus of psychology at University of Helsinki (UH). He has had a long university career with diverse range of research interests in human sciences, the brain, vision and communication research, human technology, organizations, the virtual and media. He has also been in prominent administrative positions such as a dean of Faculty of Arts in UH.

Tuomas Paloposki is a senior university lecturer in the Department of Energy Technology in School of Engineering. He is the teacher-in-charge at the course Combustion and Gasification Technology at which the sustainable developement topics are integrated in.

Heikki Remes is an assistant professor in marine technology at the Department of Applied Mechanics in School of Engineering.

Esa Saarinen is a Finnish philosopher and a professor of applied philosophy at School of Science. Among other things he has taught highly popular courses on Applied Philosophy, Philosophy of Life, and Systems Thinking.

Fabian Sepulveda is a startup coach, Lean Launchpad trainer, and Entrepreneurship lecturer at the Aalto University School of Business and the Aalto Ventures Program. He has over 15 years of international working experience in engineering, management consulting, and investment banking.

Maire Syrjäkari is a development manager in the University Pedagogical Training and Development unit of Aalto University.

Timo Tapola is an educational counselling psychologist at Aalto University. He has also worked for Tekniikan Akateemiset (TEK).

Filip Tuomisto is a professor in nuclear engineering in School of Science. He is the teacher-in-charge at the course Introduction in the Nuclear Energy Technology.

Jari Ylitalo is a post-doctoral researcher and development expert in the Department of Industrial Engineering and Management. He is involved in research and teaching, but he has also been intensively engaged with different development projects on leadership in Aalto University.