Multi-perspective Requirements Engineering Education with focus on Industry Relevance

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Abstract

Requirements engineering education should be based on best-practices and techniques, but it also needs to be anchored in state of the art research and the reality of industry practice. Preparing students for practice involves giving them an accurate view of reality as well as giving them the tools and the critical mindset needed to perform and improve on requirements engineering practices in industry.

By utilizing experiences close to students it is possible to put abstract theory and practices in a context, as well as accomplish a deeper learning. In this article, we present a complete requirements engineering course aimed towards mature students.

1. Introduction

Many professionals in industry performing requirements engineering tasks lack formal training [1] in the field. This coupled with that one of the most common reasons for project failure can be traced back to deficiencies in the requirements engineering process [2-7], speaks for itself. There is a need for requirements engineering education as a part of the engineering curriculum. Further, this education needs to be industry relevant and pragmatic in nature, focusing on aspects important for practice in order to be useful. This includes basic practices and skills associated with Requirements Elicitation, Analysis & Negotiation and Management of requirements [8] in traditional bespoke (customer-developer) development [9]. In addition, implications on requirements engineering posed by new ways of working in industry need to be addressed to prepare the engineers in training for the demands posed in the near future. This can include market-driven product centered development [10] and product family development (see e.g. [11]), and their implications for requirements engineering activities.

Requirements engineering education should thus rest on three pillars: basic skills (as taught in many requirements engineering books), State of Practice (how requirements engineering is performed in industry, and the demands on requirements engineering practices that industry poses), and State of the Art (the current research front in requirements engineering). These are of course not separate entities but are communicating vessels, and hence all three pillars must be a constant and continuous part of the education. Thus, the research state of the art and the industry needs are indications of the direction of the education as well as input to the curriculum. Moreover, adequate means must be provided for the students so that they are able to absorb the different perspectives. This may involve discussions, seminars, and practical application of the taught techniques, methods, and models. It also involves establishing an environment where the students are encouraged to reflect upon what is taught and allow them to connect the requirements engineering theory and practice to their previous knowledge and experiences.

This paper presents the software engineering master level course in requirements engineering given at Blekinge Institute of Technology (BTH), Sweden[1]. The course is presented using two equally important perspectives. First, the content of the course is described, and second the didactics of the course are explained in relation to the contents of the course.

The paper is organized as follows. Section 2 gives the background information to the course, and establishes what prerequisites are demanded from the students. Section 3 gives an overview of the educational contents of the course, and Section 4 shows how the contents is

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[1] The course has a homepage available at: http://idenet.bth.se/servlet/courseoccasion?course=2914&lang=en
where information about the course and ongoing course occasions is continually added and updated.

taught and equally importantly how a learning environment is established through the combination of several teaching techniques aimed at involving students making them active participants in their own education. In Section 5 experiences regarding contents and didactics are discussed, and last Section 6 offers our conclusions.

2. Context and Background

The requirements engineering course described in this paper is designed for a fairly mature audience. The main target audience is graduate students (master students) in the software engineering curriculum at BTH. The students have experience in areas such as development (e.g. software architectures, design, and programming), management (e.g. project and quality management), and quality assurance (e.g. verification & validation, and software metrics).

An important prerequisite for the course is that the students have some form of practical software development project experience (either from industry or as a part of their previous education), corresponding to at least 20 weeks of full-time work in a larger development project. This coincides well with the software engineering education at BTH where part of the education consists of a mandatory industry initiated live development project. This project is typically around 16000 person-hours, and mimics a real software development project with an industry customer, several end-user categories, and a software development department manned by university staff consisting of roles such as head of department, quality coordinator, architecture evaluation team, software process auditor, etc. The large team project is a culmination of several smaller projects where different software engineering skills are in focus. Throughout the entire education a culture of commitment is taught, and in fact as much as 25% of the education consists of industry initiated development projects. This has been further described in e.g. [12, 13].

The main idea behind the fairly strong prerequisite of previous project experience is that students are able to continuously relate the theory, skills, and techniques taught to their own practical experience during the course. Critical thinking and questioning of both state-of-practice and state-of-the-art is an intricate and critical part of the requirements engineering education, as well as a part of the examination. A large portion of international students from diverse backgrounds is an additional input to this, because of the many perspectives they introduce in the course.

The course is given over 10 calendar-weeks half time studies (7.5 ECTS credits or 200 person-hours full time work per student). The number of students varies from year to year. During the most recent course occasion 25 students participated. Previous years there have been between 60 to 80 students.

3. Educational Contents

The course contents can be divided into three distinct parts, building on each other in an evolutionary manner.

Traditional requirements engineering practices and methodology centered on bespoke project centered development forms the base. Following this a market-driven perspective is given to requirements engineering, where products and continuous market-driven development is presented. Last but not least, industry relevance and practical application of the practices is premiered as a part of the contents and as a part of the didactics.

There is also a fourth part that is interspersed throughout the entire course, namely process improvement.

In the remainder of this section we discuss each of these parts further.

3.1. Traditional Requirements Engineering

Many requirements engineering textbooks have a project focus. Requirements are elicited, analyzed and negotiated, specified, and managed over the duration of a development project. In addition, three main process areas are commonly recognized and accepted, namely Elicitation, Analysis and Negotiation, and Management [7, 8, 14-16].

Each of these main process areas is comprised of several sub-processes and ultimately practices/techniques that can be used as "tools" in requirements engineering.

In the context of the course, the project centered requirements engineering as described above is called traditional or bespoke requirements engineering, and it is the foundation and initial part of the course.

In the course, each main process area is placed in a larger context of product development. It is then scrutinized further, and techniques are elaborated upon in detail. Good-practice examples are given, and some practical training is offered. Because of the students' previous project experience, the focus is however mostly on reflections rather than practical training. In some cases the course has been given for students with less experience[2]

[2] Specifically, it has been given for the ICT masters' program at the National University of Rwanda.

and then more practical exercises have been included as well.

The techniques/areas taught can be summarized as follows:

- **Elicitation**. This involves areas such as stakeholder identification, stakeholder analysis, elicitation techniques (e.g. interviews, scenarios, prototyping, facilitated meetings such as workshops and focus groups, and observations), requirements reuse, domain consideration, cultural aspects, etc.
- **Specification**. Includes discussions of what is a good requirement, abstraction levels, level of detail of the requirements, different types of requirements (e.g. data, functional, interface, managerial, or quality requirements), different ways of specifying the different requirements, users of the requirements specification, traceability, and the requirements document.
- **Analysis & Negotiation**. Discussions of the need for analysis and negotiation, techniques for conducting the analysis (e.g. checklists, interaction matrices, requirements prioritization from the perspective of rationale as well as different techniques, and risk analysis), and how to conduct customer negotiations. Requirements Validation, and techniques for this, is also discussed.
- **Requirements Management**. This part of the course contains discussions of how to maintain the requirements once they are developed, including change management and processes for controlling changes, and tools for managing requirements. Requirements traceability is also elaborated further on, and the notion of a requirements management policy is introduced.

As a complement to the “text-book” examples, state-of-practice examples from industry are put forward continuously as a comparison, giving students a “reality-check”. In some instances these industry examples of how techniques are used differ substantially from the text-book examples. The differences can be examples of best-practice vs. good-enough, or sometimes examples of insufficiencies in industry. The connection and exemplification of how practices and techniques can be applied in industry anchors theory in practice and explicitly shows potential problems that the students might encounter in industry, as well as the potential benefit of using a certain technique. Research state-of-the-art is also tied into these discussions wherever applicable to show alternative solutions that should or could also be considered and discussed.

3.2. Market-driven Product Centered Requirements Engineering

After the students have covered the basic concepts of Elicitation, Analysis and Negotiation, Management (and Specification), the focus is altered somewhat. This implies moving from project and customer-developer relationships to product focus and markets as the driving force behind product conception and development.

Pre-project requirements elicitation is covered, since requirements in a market driven environment come from several internal and external sources. The internal sources include e.g. developers, marketing, sales, support personnel, and bug reports. The external sources include e.g. users, customers and competitors, and requirements are often gathered via surveys, interviews, focus groups, competitor analysis etc. [17-19]. The volume of requirements that needs to be handled makes initial screening important in order to decrease the risk of overloading in the evaluation and realization process [20].

The students are presented with techniques for sorting and structuring large quantities of requirements as they come in to an organization [21, 22]. Initial screening of the requirements (a basis for early acceptance or dismissal) is explained as well as how product strategies and/or product road-maps can be used for this purpose [21, 22].

As requirements are screened the ones left are prioritized, grouped into development packages, taking coupling and cohesion between requirements into consideration, and sent to development projects for realization.

The market-driven, product-centered requirements engineering is not a substitute for bespoke requirements engineering, but rather a variant meant for market-driven environments. Many techniques taught as a part of bespoke requirements engineering are reused in market-driven requirements engineering (e.g. specification, analysis, and prioritization). The main difference is that market-driven requirements engineering focuses on large quantities of requirements coming in to a company in a continuous flow, therefore initial screening and selection is premiered. As requirement packages are sent to development (e.g. development projects), bespoke techniques can and should be used to further refine and analyze the requirements.

In addition to initial specification, screening and selection (comparing to strategies or road-maps and prioritization and packaging) early validation of requirements is exemplified using test-cases and or use-cases pre-project.

The techniques and areas taught in the market driven part can be summarized as follows:

- **Initial (Pre-project) Specification**. This part contains discussions on what is good-enough for pre-project screening. Discussions are held regarding how a requirement is specified based on input that can vary in form and detail, and what forms it may take. Among other things abstraction of requirements, traceability, and refinement (technical detail) are discussed and compared with the purpose of examining what decision support is needed for screening and selection of requirements for realization.

- **Screening and Selection**. This part covers comparison to road-maps and product strategies as a way to use several sources as input to what is to be accepted for realization. These sources are both directives put forward by management through strategy and planning, but also technical considerations like dependencies and packaging for obtaining an optimal development environment with regards to coupling and cohesion between requirements and requirement groups. Requirement prioritization and planning is also covered.

- **Screening and Selection Evaluation**. The quality and accuracy of the selection of requirements for realization is also discussed. For this purpose different techniques are covered, e.g. GAP Analysis [23-25] and Customer Value Analysis [26]. In addition adherence to internal strategies and road-maps is also discussed and techniques such as Internal Value Analysis [19, 27] are a part of this work.

- **Product Family/Line Development.** This part contains discussions covering areas like Product Portfolio Scoping [28], and core assets [29].

3.3. Process Improvement for Requirement Engineering

In addition to bespoke and market-driven requirements engineering an introduction is given to the concepts of software process improvement with focus on process assessment and improvement for requirements engineering. Best-practice frameworks are discussed as well as assessment frameworks like CMMI [16]. The generic assessment frameworks (e.g. CMMI) are covered in more detail in other courses, so only the parts specific to requirements engineering are detailed in the course. Apart from discussing assessment frameworks, the different requirements engineering practices introduced in the course are presented with a mind towards process improvement throughout the entire course.

The intention is to introduce the concepts of process assessment and improvement, preparing students to take an active role with regards to the requirement engineering process at organizations where they will be practitioners. Giving the students an idea of available tools and techniques (and pros and cons with these) also prepares them for the industry case study which is a part of the course work (see Section 4.2.3).

4. Educational Didactics

This section covers the didactics and examination of the course, and demonstrates how industry relevance and practice is incorporated in the course, as well as explicitly stating some of the unique success factors associated with how theory and practice is combined to prepare students for industry.

4.1. Lectures

A series of six three-hour lectures and two discussion seminars are given as a part of the course. These lectures are all concentrated to the earlier stages of the course. The intention of these lectures is to give a brief overview of the theory as presented in the course literature but mostly to cover those parts that are not presented in the course literature. This involves different state of practice viewpoints from alternative literature sources, state of the art from research articles, as well as industry experience.

The format of the lectures is a variant of the "students listen while teachers lecture". In the long-established traditional school of didactics [30], the teachers are central along with the knowledge and experience they possess. In our case the competence of the teachers is paramount, but so is the active participation of the students. Discussion and to challenge dogma and established principles is not only allowed, but encouraged. Student participation is constantly encouraged and actively sought, and support is given to help the students formulate their arguments in a clear and rational way, and ideally to connect their arguments to their own practical experiences. Active probing of the students by the teachers along with *tag-team lecturing* stimulates continuous discussions and a clear connection between theory and practical usage in industry based on practical experience elicited from students and the teachers.

Tag-team lecturing is a practice based on having two lecturers in the auditorium at all times. One is responsible for the lecture, and executes the lecture in a fairly traditional manner. Lecturer number two sits in the class and offers complementary information. It can be described as giving students real practice examples continuously, complementing every block of theory with examples, pros, and cons based on industry experience and/or alternative views. In some instances the two lecturers disagree on a point, presenting two (or more) possible techniques or solutions to the same problem. Both propagate for their alternative in front of the class, not only showing that most problems have more than one solution, but also that it is acceptable to engage in discussion. The lecturers take turns lecturing and offering alternative views or practical examples.

The tag-team approach is not seen as a disturbing, but rather as a natural way of utilizing expert knowledge from two resources, maximizing the return for the students and stimulating discussions and inquisitiveness. Optimally, the students draw on their own experiences when challenging or complementing the views of the lecturers. During this process they also share industry practice examples with their fellow students.

From this perspective the teaching focuses on the subject area and knowledge and experience from the knowledge area, i.e. both the student and the teachers can exchange knowledge and "teach" each other. This way of lecturing is not purely instrumental in the aspect intended by Modernism [30], i.e. A (tag-team, challenging students) does not always give B (active participation and exchange of knowledge). However, our experience is that teaching in this way makes learning and active participation and exchange possible to a larger extent than would be the case with traditional (almost exclusively) one-way lecturing. With this in mind, the lectures are to some extent a mix of pedagogical Traditional and Modernism schools, i.e. teaching as making learning possible [30]. There is a part relying on the teachers and their knowledge and experience. But in addition, involving students and making them active participants in their own education builds motivation, and also gives them a sense of ownership. The students themselves become active in assuring the quality of the course contents by not accepting bits of information but rather demanding knowledge [31]. From this perspective the teachers become more than lecturers, and take the role of guides and moderators.

4.2. Examination (Work Assignments)

Examination is used as a part of student learning, in contrast to just testing knowledge acquired from books and lectures through e.g. an exam. The students are asked to utilize the knowledge gained from the lecture series and their own literature studies, and delve deeper into both theory and practice utilizing research papers and books. Practical industry connection is also a part of the examination. All of this is concentrated to three assignments, each described below. All three assignments are report-based, i.e. the students write reports that the teachers grade and give feedback on. The assignments are described in a 3-page document, and the students are expected to consult books, articles, and other sources on their own in addition to the, intentionally brief, assignment description.

4.2.1. Bespoke Requirements Engineering Assignment

In this assignment the students are expected to write a report that describes the practices and technologies used in bespoke requirements engineering. Part of the examination is to ensure that they have a broad understanding of what constitutes requirements engineering.

The students are also asked to relate the theory to their own personal experience and to research literature (five relevant requirements engineering related literature sources (books and peer reviewed research articles) is the minimum requirement). Throughout the report the students are expected to reflect upon the described practices. Examples of questions that the students are encouraged to ask and answer are: Do they think the practice will work as described? If not, why not? Do they have experiences with using a specific practice or technology? What were the consequences of applying a specific technique in a certain way? How could they have done differently? What do they think would have been the consequences of applying a different process?

As mentioned, the produced report is used as an examination of the students, i.e. it is graded and this grade is included in the students' final grade on the course. However, there are two even more important benefits gained from the assignment. First, it encourages the students to reflect upon the topic, and upon what they already know, in a structured way. Second, it enables the teachers to pinpoint where the students have misunderstood the subject, where the students may need to dive deeper to get a full understanding of the subject, and where the students' interest lie. Feedback on the report can then start a dialogue between students and teacher to provide further pointers and literature sources that the students may benefit from.

This report is estimated to take 70 person-hours and has a maximum page limit of 10 pages in the IEEE template, not including references.

4.2.2. Market-Driven Requirements Engineering Assignment

In this assignment the students are asked to write a report that investigates the concept of market-driven product-centered requirements engineering. The students are asked to contrast market-driven requirements engineering against traditional bespoke requirements engineering with the purpose of bringing forwards the unique challenges with requirements engineering from this perspective. This includes:

- **Continuous product development**. Seeing past projects and towards product evolution with aspects such as release planning, products in different parts of their life cycle e.g. utilizing the BCG matrix.
- **Product Management**. Investigating the role and the tasks associated.
- **Product Strategies**. Looking into how product strategies and plans (product roadmaps) are constructed, how they can be used for decision support regarding requirements selection and prioritization, and realizing drawbacks, e.g. if no or bad formulations of product strategies are the main source.
- **Large Quantities of Requirements**. How large masses of requirements coming into an organization can be handled continuously - without either overloading, or the organization missing to recognize vital requirements.
- **Specification and Abstraction.** Specification and utilization of attributes in initial (pre-project) requirement specification. The possibility to use different abstraction levels of requirements for different purposes.

Utilization of research literature and reflection using personal experience (as described for the bespoke assignment) is a prerequisite into completing the assignment. However, there is less literature covering the aspects of market-driven requirements engineering, forcing the students to delve deeper in research, and also use other resources in addition to software engineering literature. An example of this is the need to utilize e.g. management literature, giving students the realization that the area is complex and multidisciplinary.

This report is estimated to take 80 person-hours and has a maximum page limit of 15 pages in the IEEE template, not including references. In a way, the extra pages in this assignment compared to the bespoke assignment makes it easier for the students as they do not have to condense their argumentation as intensively to fit within the page limit.

4.2.3. Industry Case Study Assignment

This assignment consists of four different parts: plan, perform, present to students, and present to company.

In the first part, the students in groups of four plan a case study into the requirements engineering practices of a company of their choice. This is a fairly shallow case study aimed at giving a broad overview of the practices in that specific company. In order to design the study and plan which questions to ask, the students need to read up on the theory of requirements engineering and to some extent process assessment. As a help they get a minimal set of questions that they should seek an answer to. This is provided to ensure a minimal quality level and act as a least common denominator between the different student groups. The students can also utilize the information given during the process assessment and improvement lectures (see Section 3.3).

In general, the students have no problems finding companies to investigate. The region (Blekinge) contains an active software engineering community with companies that are benevolent and open to the university and the students. In addition, the students often seek companies outside of the region, e.g. where they have been employed previously, for whom they have conducted student projects, or where they have acquaintances that work. The companies that the students have to date investigated cover all types of branches and company sizes, from small development companies with 5-10 employees to large international software development companies and consultancy firms.

In the second part, the students visit their chosen company and conduct interviews with key personnel. The assignment does not control their choice of case study method but most students choose interviews as this is a form that is familiar to them. In the same way, the assignment does not control how many subjects that should be interviewed. Most groups conduct one interview, but it happens that groups conduct several interviews and triangulate the answers. Once the study is performed, the students are expected to write a report on their findings, summarizing the practices of the company, and to reflect upon what works well for the company (and why it works well), and what practices that have room for improvement. The findings shall also be discussed in relation to literature (books as well as research articles).

It should be noted that the investigation into a companies requirements engineering practices affords the students hands-on practice with several elicitation techniques, e.g. interviews and domain analysis.

To increase the value for the company, and in an attempt to spread the burden for the companies, the students are also requested to (a) suggest improvements and motivate these for the company, and (b) if the company has been studied previously the students shall relate their study to previous findings and investigate if the company is improving on their requirements engineering practices. We believe that these two tasks increase the value of the report for the company, and makes them more interested in participating the next year. The second task (task b) may need some more explanation. While students in general defy categorization in terms of how much work they are willing to perform in a course, there are two extremes that can be identified. At one extreme we have the very conscientious students who want a challenge and are going to perform well. For these students, task b provides an extra challenge and increases the value of their work to the studied company. At the other extreme we have students who basically want to manage the course with as little work as possible. These students will quickly identify that if they find a company that has not been studied before, they can reduce their workload. This will reduce the burden for companies that have been studied in previous course occasions, and will also give good examples of new companies to be used in the course in subsequent years.

In the third part, the students give a presentation of their findings to the rest of the class. This helps disseminate their findings and means that the students see the "insides" of more than one company. This gives them better insight into the current industry state of practice.

In the fourth part, the students deliver their report back to the company, and are sometimes asked to present their findings to the company. The value of accepting students into their company thus increases, and it forces the students to be more careful and truthful when reporting on the company's practices and to be more realistic in their suggested improvement proposals.

Practical training in elicitation techniques (eliciting both current state of practice in companies, and possible improvements), and a connection to industry practice increases student motivation as the work is done with a goal other than "just completing a course" in mind. The students are faced with the responsibility of interacting and contributing to a real company.

This report is estimated to take 80 person-hours and has a maximum page limit of 15 pages in the IEEE template, not including references.

4.3. Non-Graded Assignments

One additional assignment has been tested in the course during the last course occasion: to conduct a research experiment in requirements engineering with the help of the students. This experiment is chosen so that it will have a contribution towards the course goals, i.e. the students will learn something about requirements engineering by participating.

Briefly, the experiment included in the most recent course occasion revolves around the complexities of specifying requirements, handling abstraction levels, and relating requirements to each other. The experiment is run during a 3 hour practical work session. From the student perspective it can be seen as practical training in requirements engineering, and to some extent product management. The product management aspects are centered around asking the students to select requirements, dismiss requirements not in line with product strategies, and base decisions on relationships between requirements and overall product goals.

Moreover, the experiment is conducted transparently so that the students get an insight into experiment design. This can be seen as a precursor to a separate course on research methodology that the students also take during their masters' year. It is, however, strongly emphasized that the results of the experiment will not be used to grade the students.

After the experiment has been conducted, de-briefings, additional assignments, and discussions are held to get as many points as possible across to the students, and to anchor the practical work performed during the experiment with theory and reflections.

5. Experiences and Discussion

In the previous sections we discuss the contents of the requirements engineering course at Blekinge Institute of Technology, and how the course is conducted. From this we identify a number of "success factors" that define and permeate the course, further described in this section.

Reflection instead of practice. Because the course is held for master students, and because the students have previous experience from relatively large industry initiated software engineering development projects, the course is focused on reflections rather than numerous practical assignments. Theory, current state of practice, and state of the art are analyzed by the students using their own experience as a base, rather than inventing fake requirements, situations, and problems. This is of course made possible since the students have practical experiences from development and requirements engineering coming into the course.

Our experiences with this is that although the students find it challenging to try to think about their experience in this way, they are often pleased with the result afterwards. We can also see in our discussions with the students that they gain a deeper understanding of the subject since they are able to see it in the perspective of personal experiences.

Market-driven requirements engineering. The complexity of product development is not really represented by the bespoke requirements engineering practices that dominate most text books. For this reason, the complex reality of market-driven product centered requirements engineering and product development is put forward as a complement. The main idea is to prepare students for industry, and not stick to accepted practices and views that to some extent do not reflect reality.

It is however important to realize that in our case we provide the market-driven perspective as a complement, utilizing things learned from traditional requirements engineering, but taking it a step further by showing how traditional practices and techniques can (or can not) be used in another context.

Research connection. Rather than just having a course about best practices, the intention is to also provide an up-to-date view of current requirements engineering research. State of the art research is thus included in the lectures, and the students are expected to have a strong research connection in their assignments. In our experience, the students often use a small set of "obvious" literature sources for the first assignment but when the assignments move to the forefront of requirements engineering research (as with the report on market-driven requirements engineering) the students are able to follow, and are capable of identifying and using relevant and recent research results. As a forerunner to e.g. their masters' thesis, this gives the students good practice in absorbing and critically investigating the current state of the art research.

Industry Connection. Theory is constantly tied in with the experiences that the teachers have from industry state of practice on requirements engineering, and the students are also involved and encouraged to reflect upon their own industry experiences (real and/or simulated through prior student projects). During the lectures, a student may be asked to tell the other students how they work in a company that he or she is or has been affiliated with. This is then discussed in class with active participation of all students, and in particular the student that first provided the experience. During the assignments the students are requested to connect the theory with their own experiences and with their observations from industry. Hence, a culture of sharing and understanding industry state of practice is nurtured, and one student's experience is shared with others, giving all additional points of reference in reality to anchor the theory provided by literature.

The case study performed offers a reality check. The students get a first hand view of state-of-practice, realizing that industry reality is not the same as in academia. In addition, each student group gets this reality check affirmed as all groups share results through seminars after the process assessments, making it possible to identify similarities and to some extent common challenges between companies. Connecting this to studies performed in research prepares students for industry practice, and gives them an idea of how they could contribute in industry as they themselves become practitioners.

Tag-team lecturing. Requirements engineering is not an exact science. We felt it was important to challenge the students to think for themselves, realizing that the tools and techniques used for one situation may be inappropriate for another. As most teachers know, getting students involved and passionate about a subject is no easy matter. Tag-team lecturing enables holding a healthy academic dialogue in the traditions of Socrates and Plato. This makes the subject come alive, and shows that there is more than one view of a single subject (partly because two lecturers complement each other, and partly because of the discussions). This not only demonstrates that most problems have more than one solution, but also that it is acceptable to question theory and dogma as long as the motivation behind the skepticism is well formed. In some instances this means not accepting a certain technique or practice propagated by e.g. a book, but often it means realizing the potential as well as the limitations of the techniques and practices available. With two viewpoints (or more, since the students participate) advocated in a discussion, a sense of which techniques are available and appropriate for a certain situation is quickly reached.

Active student involvement and participation is a prerequisite to getting individuals to take responsibility for their own learning [32]. Tag-team lecturing is one of the methods we utilize to achieve this. Another is giving students control over their situation as they are able to, to a large extent, control the examination assignments regarding level of ambition, coverage and depth. A minimal level of effort is required, but often students delve deeper into areas of interest, investigating and connecting to practice, which ultimately leads to a much deeper and more complete understanding than would be possible with e.g. an exam or a quiz.

An intricate part of the work and assignments is having continuous feedback. The students are offered individual teacher feedback on every assignment, with the possibility to complement the work done in a continuous manner. In addition, discussion seminars provide further possibility to investigate, question, and clarify aspects of every assignment, or indeed any part of the course.

Continuous Course Improvement. The course is continuously evaluated, using discussions with the students, student surveys at the end of the course (university required course evaluations), as well as discussions among the involved teachers and other members of the faculty. Overall, the students are in the course evaluations positive about the course and the course contents and often only suggest minor changes. The discussions among the involved teachers often result in larger modifications of the course layout, in particular the assignments. Discussions with other faculty members give good ideas that are also considered when the course is constructed for every new course occasion.

Since 2001, when the course took on its current form, parts of lectures have been improved, and some lectures (e.g. on market-driven requirements engineering) have been added as a response to a changing requirements engineering market. The assignments have undergone considerable evolution practically every course occasion based on student and teacher feedback. For example, there used to be an assignment where the students could write a research article on any requirements engineering topic. This was replaced with the two reports on bespoke and market-driven requirements engineering, to ensure a minimum level of knowledge and a better ground for setting comparable grades. The industry case study and the subsequent report has existed in various forms since 2001 but has evolved in terms of required contents and in terms of the significance given to it in the course, as we have found further ways of using it to encourage reflections among the students. The report on market-driven requirements engineering, only recently introduced, will change format (but not importance) before the next course occasion since it was too difficult to give a fair grade on it and it was perceived by the students as having too much overlap with the bespoke requirements engineering report.

6. Conclusions

This article describes the contents, the didactics, and the experiences from a set of success factors for a course on requirements engineering held at the software engineering masters' program at Blekinge Institute of Technology.

We describe how the three pillars of basic skills, industry state of practice, and research state of the art are taught as integral parts of the same course. The teaching is done using active student involvement and participation, where the students are encouraged to reflect upon their previous experiences as well as literature, research articles and industry practices. The course is to a large extent discussion based, with discussions between the students, between the teachers, and between the students and the teachers.

It is possible to utilize the master level students' own experiences as a base for anchoring and discussing requirements engineering practices, techniques, and processes. This connection establishes an environment where *deep learning* is facilitated, in contrast to *surface learning* which sadly is too common in academia [32].

This is however not enough. Making the students key stakeholders in their own learning is a prerequisite for gaining motivation, involvement and through this, effective learning [30, 33]. The students are given responsibility and freedom to focus assignments according to need and interest, as there is no micromanagement of the assignments' contents. Equally important, trusting students to do a good job is also a part of this equation, allowing them to go out to the real world and interact with companies.

The course is constantly improved upon. Based on the feedback and the discussions during one course occasion, the course is adjusted or re-worked to the next course occasion. We thus apply the same standards of continuous, market-driven requirements engineering and process improvement that we teach in the course, to the course itself. This, and the success factors discussed in Section 5, means that the course will never be exactly the same from one occasion to the next.

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