Education for Professional Practice: Runestone Model

Patricia Alonso
Abstract

Education for Professional Practice: Runestone Model

Patricia Alonso

Nowadays, types of production and process technology are present in most of sectors of the economy. The rate of progress is very fast and the manner in which technology is deployed and used undergoes continuous change. This is perhaps especially true for Information Technologies, where computers now have a great influence on our society. Therefore education in Computer Science should respond to the nature of the discipline and also be very dynamic.

In higher education, the transition from University to the beginning of professional career is a crucial moment for students. Education in Computer Science is focused on technical skills. Typically not much attention is given to the non-technical skills needed for life as a computing professional.

This thesis studies the current state of education in Computer Science, and how it trains students for their future professional career and factors that increase their successfullness and competitiveness in Industry. Universities typically provide students with an excellent technical education. But, nowadays the profile of professionals in Computing requires also other complementary aspects.

For this study, the thesis investigates an innovative approach to integrating professional practice into University education. The Runestone project, a course given since the mid 1990’s is a collaboration between the Universities of Uppsala (Sweden), GVSU Allendale, MI (USA) and Turku (Finland). This course, with its international perspective, hopes to train to the students not only in technical skills but also in non-technical skills representative of modern professional practice. The course encourages the students to realise the importance of these other aspects, understanding the function of a professional with a wider perspective.

The thesis studies the 2007 offering of the Runestone project. It analyzes the experiences of teachers and students, drawing on interview and survey information. Data sources include interviews and survey responses from the teachers of the three participating Universities as well as students from the three countries involved.

The thesis has two objectives: to study the attitudes of the teacher in regard to the intention of the course and the study of students as they gain experience as a result of the course. The part of the analysis dealing with the teachers is centred in the study of their vision of the current education of Computer Science, their motivations and objectives of the course, the structure, methodology and tools used for it, the course as international project and the importance of the learning of communication in team. The part of the analysis of student’s experience and motivation is centred in their vision of the courses role in their future professional practice in computing, motivations for the course, acquired skills during the course, how they worked in a team and the course as an international project.
Acknowledgements

First of all, I would like to express my sincere gratitude to my supervisor Arnold Neville Pears, Professor of the Department of Computer Systems of Uppala University, for all his help and encouragement during my research so far.

Special thanks also go to the other two teachers that very kindly collaborated in my thesis, Robert Adams, Professor of the School of Computing and Information Systems of Grand Valley State University (USA) and Seppo Virtanen, Professor of the Department of Information Technology of University of Turku (Finland) for their really useful information and good advices.

Furthermore, I wish to thank all students from Sweden, Finland and USA that collaborated in my thesis for taking their time and very useful information.

Finally, very special thanks go to my family and to my friends.
1.

1. Introduction ........................................................................................................................................ 7
   1.1. Overview of the thesis .................................................................................................................. 7
   1.2. Computer Science and education. Bologna programme .......................................................... 8
   1.3. Step from University to professional practice ........................................................................... 10
   1.4. The setting .................................................................................................................................... 10
   1.5. The research questions ......................................................................................................... 11
   1.6. Methodology of study ........................................................................................................... 12

2. The research approach: study in the context of ‘Runestone Model’ .............................................. 14
   2.1. Objectives of teacher .............................................................................................................. 15
   2.2. Course documents .................................................................................................................. 16
   2.3. Grading guidelines ................................................................................................................... 18
   2.4. Course structure & management .............................................................................................. 19

3. Teachers: the intention................................................................................................................. 22
   3.1. Data collection and analysis .................................................................................................... 22
   3.1.1. Motivations and objectives .................................................................................................. 23
   3.1.2. Are students prepared to face up professional work? ....................................................... 25
   3.1.3. Three direction teaching: skills in technical, teamwork, management ............................ 26
   3.1.4. Resources used: Methods and tools of teaching in the course .......................................... 30
   3.1.5. Innovation vs traditional teaching ...................................................................................... 33
   3.1.6. Development of creativity to stimulate students ................................................................. 35
   3.1.7. International collaboration and cultural differences: Runestone course, involved different countries and Universities ......................................................... 37
   3.1.8. Communication in the team .............................................................................................. 40
   3.1.9. Assessment of results ......................................................................................................... 41

4. Students: the experience results................................................................................................ 43
   4.1. Data collection and analysis ................................................................................................... 43
   4.1.1. Motivations to study Runestone course .............................................................................. 44
   4.1.2. Step from University to professional practice .................................................................... 45
   4.1.3. Acquired skills during the course .......................................................................................... 46
   4.1.4. Methods and tools in Runestone course ............................................................................ 48
   4.1.5. Work in a team ..................................................................................................................... 49
   4.1.5.1. Communication ............................................................................................................. 50
   4.1.5.2. Brief evaluation of the team .......................................................................................... 52
   4.1.5.3. Effective meetings .......................................................................................................... 53
   4.1.5.4. The decision-making ...................................................................................................... 54
   4.1.5.5. Estimation of work plans ................................................................................................ 55
   4.1.5.6. Strength and weakness of teamwork ............................................................................ 55
4.1.6. International project........................................................................ 57
4.1.7. Opinion results.............................................................................. 59

5. Conclusions .............................................................................................. 61
Chapter 1

Introduction

1.1. Overview of the thesis

This thesis is the outcome of a study about how the higher education in Computer Science trains the students for professional practice. For this aim, the thesis is focused in the research of the project Runestone, an ambitious course carried out by universities of three different countries: Sweden, USA and recently joined, Finland. The course consists of the development of a technical large project between students of University of Uppsala (Uppala, Sweden), GVSU Allendale (Michigan, USA) and University of Turku (Turku, Finland).

For students in computing to go from University to professional work is a crucial point in their careers. The degree of Computer Science is very focused in technical issues and not so much in other necessary skills in professional practice. That is why Runestone project course tries to give to students a more complete vision about the achievement of a project of computing in professional practice.

The thesis project called ‘Educating for Professional Practice. Runestone course’ studies the attitudes, motivations and experiences of the project Runestone developed in the environment of different Countries and Universities. The thesis is focused in two parts: the first one is the experience from teachers in the Runestone project course, that it is identified as THE INTENTION of Runestone course. The second one is the experience from students in the Runestone project course, that it is identified as THE EXPERIENCE RESULTS of Runestone course.
The thesis is structured in 5 chapters. The chapter 1 is an introduction of the thesis. Here is analyzed the current state of the higher education focused in Computer Science and the methodology of the study in the thesis is described. The chapter 2 explains the research approach Runestone project: the profile, features and how works Runestone Model. The chapter 3 describes the experience of teachers in the course. In this chapter is showed the data collection from teachers and the analysis of the information. The chapter 4 describes the experience of students in the course. Data collection from students is showed and the analysis of the information. The last chapter presents the conclusions and implications of the thesis.

1.2. Computer Science and education. Bologna programme

Higher education plays an essential role in society. Higher education is responsible to train the future professionals and create new knowledge through the investigation. Its function is fundamental in the development and success of economy and society of a country.

Nowadays, the constant development of technologies of information and communication and the more and more frequent economic relations between countries are creating a new framework of performance of the society and economy. Higher education must adapt to the changes and must be appropriate to the current circumstances. In Computer Science is more evident this change and evolution where technology has a huge influence, so teachers and students have had to modify their tasks at University.

These days, Europe is aware of the importance of higher education for the society. European professionals in higher education work to find which are the requires in education, analyzing the economic and social context that is really influenced by the technology, with the purpose of getting that higher education fulfills, besides other things, its function in the economy of a country.

According to European Commission about education & training, EU education and training policy looks for three overall purposes:

- Improving the quality and effectiveness of education and training systems
- Facilitating access to education and training systems
- Opening up EU education and training systems to the wider world

The EU looks for the collaboration between the different countries to improve the global education and learn from each other. To support this strategy, these days EU promotes projects like Bologna-declaration.
Bologna-declaration

Bologna declaration is an agreement between 29 countries to reform and unify the structure of the higher education. It is planned that the system will work in 2010.

It represents a commitment which each country must reform its educative system to create a system more unified in the European context. The aim is the creation of a system for higher education that improves the employ and mobility of professional and grows the international competitiveness of the European higher education.

Bologna declaration persecutes the following objectives, according the official document of bologna:

- ‘Adoption of a system of easily readable and comparable degrees’ (Bologna-declaration official document). With the implantation of a Sumplement to the diploma
- ‘Adoption of a system essentially based on two main cycles, undergraduate and graduate’ (Bologna-declaration official document). With degrees of 3 years at least with absolute value in the European labour market.
- ‘Establishment of a system of credits – ECTS system’ (Bologna-declaration official document). To apply criterion and comparable methods.
- ‘Promotion of mobility y overcoming obstacles to the effective exercise of free movement with particular attention to:
  - For students, access to study and training opportunities and to related services
  - For teachers, researchers and administrative staff, recognition and valorisation of periods spent in a European context researching, teaching and training, without prejudicing their statutory rights.’ (Bologna-declaration official document)

Bologna process tries to promote and encourage the cooperation between the different countries of European Union, taking full respect of the diversity of cultures and languages, to get an European dimension in higher education to acquire a world-wide degree of attraction. In long-term, it will let a free mobility of professionals and researchers through Europe and higher competitiveness of Europe in the world.

Computer Science degree is one of the first degrees that is being adapted to Bologna process.
1.3. **Step from University to professional practice**

Degree of Computer Science is subject to many changes and updates due to the constant evolution of technologies.

Nowadays, technologies of information and communication are integrated in a large number of services and applications in the society. Its process of develop is really quick and constantly new innovations appear in the market. Also, technology removes frontiers of communication across the countries, what means that collaboration between professional of different countries is more and more frequent.

Students of Computer Science and future professional in this field are required to have a high ability of adaptation of the changes. To step from University to professional practice, students must be trained

During the University training, students acquire large technical skills absolutely indispensable in professional practice. But these days, IT Industry demands professionals in computing with a wide profile. People with a set of skills and capabilities to be competent in the current computing market.

Development of systems are involved in frameworks, in projects that require important skills of management and work in teams and future view. The creativity and innovation are other attitudes very appreciated in computing.

People’s skills are necessary to enable professional to meet challenges of ever-evolving technologies, increasing international relations and changes. Nowadays in computing, constant learning is key to jobs and growth.

Students must learn to develop these skills, technical and not technical, during the degree to step from University to professional practice with success and competitiveness.

1.4. **The setting**

The study of the thesis is in the framework of the Runestone course. Runestone is an ambitious project that is carried out from several years ago. It is an international project which the work group is composed of students of Uppsala University (Sweden), University of Turku (Finland) and GVSU Allendale, MI (USA). This project began in 1996 with groups composed of 3 Swedish students and 3 American student. Later since 2006 the university of Turku, Finland was incorporated.

Students must design and implementate a software system that provides a user Internet access to an autonomous soft realtime robot in a remote location. In the project, students have to put in practice knowledge of earlier courses about areas like distributed systems, real-time systems and software engineering.
Runestone project tries to give students experience in large projects, developing as well as their technical skills, other necessary skills like management, teamwork, social ability, self-reliance, negotiation, communication and international collaboration. Runestone model expects to give students a wider vision about all aspects around the work in professional practice to train competitive students in their future incorporation to Industry.

1.5. The research questions

This thesis is a research about the transition from novice to expert in Computer Science, studying the Runestone course as a model to teach from the viewpoint of teachers and learn from the viewpoint of students about this transition.

For students of Computer Science to go from University to professional work is a crucial point in their career. In professional practice, experts of computing must manage aspects that seldom is presented in ordinary courses of University. The degree of Computer Sciences is very focused in technical issues and not so much in other necessary skills in professional work. The students must acquire an important level of self-reliance, adaptation to the changes, capacity of reaction, innovation, choice of suitable tools to work, organization and management skills, ability of communication and working in team, etc. Also, assignments and practicals which students face up at University are usually very defined and structured. In industry, problems often are in a fuzzy context that the students must learn to solve.

The research presented in the thesis is based on the experience of teachers and students in this course. The thesis is focused in two parts:

- the experience from teachers in the Runestone project course, that I identify as THE INTENTION of Runestone course.

- the experience from students in the Runestone project course, that I identify as THE EXPERIENCE RESULTS of Runestone course.

The set of data that has been collected as source of information consists of questionnaries and interviews.

The research questions for teachers are centred in the following aspects:

- motivations to teach Runestone course

- objectives of teaching Runestone course

- problems in learning and teaching in your opinion in Computer Sciences
• three direction teaching  
  o professional skills  
  o management skills  
  o technical skills  

• resources used: methods and tools of teaching in the course  

• reflexions about teaching in an international course involved in different countries and Universities  

• opinion about results  

The research questions for students are centred in the following aspects:  

• motivations to study Runestone course  

• objectives of learning Runestone course  

• resources used: methods and tools in the course  

• work in a team  

• reflexions about working in an international course involved in different countries and Universities  

• opinion about the results  

1.6. Methodology of study  

The study took place at Uppsala University in 2008.  

For data collection several methods have been used:  

• online-interviews  

• surveys  

• attendance to final presentation of teams in the course  

• electronic mail  

Teachers and students participated voluntarily.  

Data collection from teachers. Three teachers were interviewed, each one belongs to each participating country:  

• Arnold N. Pears, Department of Computer Systems, Uppsala University (Sweden)
For teachers, semi-structured interviews were used. The questionnaire followed a form but the order of the questions was adapted to the conversation with each teacher. The interviews were online and they consisted of individual chat sessions with a number of topics that were identified as interesting. IRC was used to fulfill the interviews with the three teachers.

Data collection from students. All participating persons of this group are students of the degree of Computer Science. All students of the last instance of the course were asked to participate in the study. Eleven of them accepted to collaborate in the study, seven from Sweden, three from USA and one from Finland. The group selected is thus representative of all participating countries.

In the chapter 4 where is analyzed the data collection of students is used symbols to identify each response to preserve the anonymity of students. The answers of the seven Swedish students are identified with the symbols S1..S7 (the order of the list with the name is not according with the numeration). The answers of the three American students are identified with the symbols A1, A2 and A3. And the answers of the Finish students are identified with the symbol F. The students were in their third and fourth year in Sweden and Finland and students of USA were in their last year of degree. For most of Swedish and Finnish students the course was mandatory whereas for American students the course was their senior project of their degree.

The study with students was conducted by 3 different methods. Firstly, I attended to the final presentation of teams in the course with connections in real-time between the different countries involved in the teams. There they explained their final project and how they work to fulfill it.

Other method was individual chat sessions with some students, using IRC, Google talk and Messenger, according with the preferences of the students. Semi-structured interviews were used with students too, adapting the questions to the rhythm of the conversation with each one. Seven of them were asked with this method. And the last method was through electronic mail for students that chose to collaborate of this way. A questionnaire were elaborated and they answered to it. Three of them were asked with this method.

The complete questionnaire for students is in the annex 2. The questions were prepared to be simple of understanding, short and direct and with the aim to cover all perspectives and aspects identified as interesting for the study. The questions were elaborated to encourage to teachers and students to express their experiences as much as possible with an atmosphere relaxed but precise.
Chapter 2

The research approach: study in the context of ‘Runestone Model’

First contact with professional practice is a crucial point in the career of the students of Computer Science.

Technical work nowadays is framed within an environment that requires other extra skills. The projects usually are fulfilled in workgroups, therefore is likewise necessary a high capability of organizations and management of teams, a suitable communication and structuration of roles inside the workgroup and suitable social abilities to do with success the required projects.

However, the high educative structure is very focused in technical aspects and not usually trains to students in other abilities requiered in any company. Thus, the student finds in many cases a gap of training in some fields which he/she has not been trained and it can make more difficult his/her success in the work market.
2.1. Objectives of teacher

Runestone project is a course that aims to give the students a different vision. Working in professional life, the work is framed in an environment with many factors. Ability to manage the projects, to stimate different factors in a project, to work of the way more efficient in a teamwork, to get suitable social relations within the teamwork are all values very important to carry out a professional project and very required nowadays. All these skills are so important like technical skills that the student goes acquiring during the degree in Computer Science.

Also, the Runestone course is developed in an international context, which gives the course other incentive characteristic to learn.

The main objectives of teachers in Runestone Model are the following:

- Management of the projects guaranteeing quality products and avoiding deficiencies
- Focusing and describing the requirements of an initial fuzzy definition of the problem
- Suitable choice and use of tools and technology
- Cooperations and trust between the members of the team
- Put in practice many technical skills
- Social skills
- Pursue innovations in the process of the project
- Solving problems and make the most of working with persons of other countries and cultures
2.2. Course documents

Documentation is an essential part of any project. When a project is executed the whole information, the results and process work of the project is turned to knowledge. The knowledge of a project must be registered for its utility and permanence during the progress of the project and during the future use of it. The students must learn to elaborate suitable documents to organize the tasks within the team, present the current work, present results, etc.

The student is assessed for the individual and team achievements. So the student must elaborate documents about himself/herself work and about the teamwork.

- Milestone reports. An element very important in the project is the elaboration of Milestone reports. In these documents is reflected the evolution of the project and the new goals that emerge during the progress of the work. Along the course each team must elaborate four Milestone reports approximately every two weeks. Milestone meetings are session to inform to the instructor about the progress of the teamwork. They are the link between the team and the supervisor. In these reports the team must show mainly the following aspects:
  - A brief summary about the current progress of the project
  - Members that are present during the Milestone meeting
  - Completed task: information about the tasks that were achieved since the last Milestone
  - New tasks, milestones and goals that the team intends to reach from this point of the project
  - Information about the meetings of the team
  - Information about the diary work of each member and the team
  - Problems encountered and solutions
  - Questions

- Analysis and design document. In this document the students must elaborate a design about the software and hardware components and the protocols between the subsystems. Firstly the team receives a very general and open requirements about the system that they must design and implement. They must take several decisions and focus the problem towards the specific solution that they decide. The design is a very important document that will guide the progress in the elaboration of the
system. Likewise is important the develop of the analysis document. Here the team must elaborate the task’s relationship and the estimation of times, resources, effort of the team, and so on. The planification of the times usually is a hard task. It is used to organize the work in the team and a good estimation of times support the project to a large extent.

- Agenda of each meeting. Documents with a register of the meeting of the team, the ‘agenda’ of each meeting. Information about the date, the place, the present members and the topics to carry out in each meeting must be documented. Also log chats are very usufil. Is very advisable, that the information of the online IRC meetings is saved to use in any moment or to use for absent members in the meetings.

- Individual work log. Besides internal progress report of the teamwork with the workflow, also is useful individual work log, to control and organize the work of each member of the team.

- Final presentation. Finally the team must elaborate a final production presentation of the project. All members of the team must be involved and they will be conducted over video-conference connection between the countries of team. They must present their project and conclude with a live demostration of the software.
2.3. Grading guidelines

In this section is explained which are the guidelines to grade students in the course, it means what is assessed and how is assessed the results of Runestone course.

Runestone course is not only a technical course, it looks for the student is able to realize that technical aspects are only a part and a project involves other many aspects so important to get sucessful results.

Runestone course aims to students get individual and team skills in three lines:

1. Technical achievements
   The technical achievements have a load of 40 points over the final grade. Teachers assess the complexity of the functionalities of the software system, the sophistication of it and how it works at the end of the project. There are three different levels of excellence to grade technical achievements. Students can develop the code of software system with functionalities ‘required’ that corresponds to technical level 0, ‘desirable’ that corresponds to higher techical level 1 and ‘advanced’ level 2 that is the highest level of technical excellence. To achieve a satisfactory technical grade for the whole course a team needs to implement all level 0 and 1 requirements.

2. Management achievements
   Management achievements have a load of 30 point over the final grade. Teachers assess the ability to organize the tasks, estimations and planifications of times, resources, efforts, the ability to reach the milestone they have defined, the ability to evaluate and make decisions about many aspects of the system, to choose suitable tools and methods for the performance of the team. The different progress reports are very indicative to grade the management of the team.

3. Teamwork achievements
   Teamwork achievements have a load of 30 points over the final grade. Teachers assess the ability of communication in the team, the ability to split the tasks and time between the different members, the ability of cohesion, the commitment and responsability of each member inside the team and the internal social dynamic that the team reaches to fulfill its goals. Teamwork is closely observed during the project and the teams are required to report regularly. Also reports about online chat communications let the teachers assess the social skills of the team.
2.4. Course structure & management

Runestone course is a project that works from 1996 and offers to students a different approach of a course in Computer Science degree.

This course involves students of 3 different countries, Sweden, USA and Finland, working a groups of 6 or 7 members normally. They have to carry out a technical project within other tasks about management, organization, teamwork, documentation and social skills.

The course looks for that students face up to a project with similar characteristics of projects in companies and professional world.

The duration of the course is about 10 weeks.

The course is structured in 3 main parts:

1. TECHNICAL PART
   The students must design and implementate a software system that accesses to a robot from a remote place using Internet via web page. The software system contains 3 main components: a robot, a server and a client/GUI.

   - The robot that uses a supplied LEGO kit must be to move its extremities using the reference of different sensors. Also, the robot will contain with a camera that offers different views, providing feedback to the human controller. The robot must be able by itself to handle collisions with possible obstacles in the patch, detecting them and navigating around. Components like the operating system used in the embedded software of the robot should be chosen by the team.

   The team must design the protocol for the robot communicates with a stationary server to receive navigation commands using IR or Bluetooth channels. The robot must handle by itself loss of communication with the server.

   - The server is an application that controls the communication with the robot and the client/GUI and handles the video stream. The requirements for the server are very open for students take decisions about the design and implementation.

   - The client/GUI displays video from the robot and allows the user navigates the robot around its environment.

The problem is fuzzy and basically defined, so the students have a wide free to define the requirements and specifications of the problem. They must manage a problem few defined and few guided so they need take initiative and solve the initial complex situation, the approach of the project.
2. PROJECT MANAGEMENT

The ability to management a team is an essential part of any project. A right management guarantees suitable progress and results for a project. Specially when projects are complex, the management gets huge importance. In many cases, the successful of projects are very influence by its management.

Therefore the team must consider this part carefully and learn to manage a team and develop skills in this field. The development of periodical individual and team reports are required.

In this part of the project the team must control the progress of the work. All members must know the current state of the project at each moment, they must know the progress of the work of other members of the team and to have a vision to plan the future step for the work.

Leader. For the management of the project, the teams determinate different roles for their members. It is a way to structure the funtionalities and the work of the team. Each team establishes a leader who represents in a way his/her team. The leader must take responsibilities of organization tasks more than other members. The leader is the link between the instructor and the team. Also, this role must supervise the correct performance of the work and the correct conduct of each member of the team. A good management of the project requires a good social environment in the group. The social skills of the members of the team have in this area a big importance. During the process of a project may emerge problems continuously and the team must be able to solve overcome them efficiently. The leader has a great role in this task.

Meetings. Other important component of the project management are the meetings. The meeting is used to know what is happening in each moment in the work, the current state of the project, to share information between the members of the team. In Runestone course is established weekly meetings. As Runestone works with international teams, there are presential meetings between subgroups of the team and global meetings with the whole team, a contact between the countries using online methods. For this meetings normally is used IRC tool over Internet. For each team is required at least one meeting per week. The results of the meetings is saved in logs to keep all information. This is used to have a layout of the weekly progress of the work, to catch up with the other team mates in the other country and to put the information available for members that maybe they could not attend to the meeting. The team must be able to choose the online tools and methods more suit for the meetings.

Milestone Meetings and reports. Also, an essential part of Runestone course is the called Milestone meetings and Milestone reports. Periodically, the team must contact with the supervisor for he knows the progress of the task, the made decisions, the plan of the task, time and resources and questions about design of the project. It could be similar to meetings with the customer in a company. With this meetings the team take contact with the exterior requirements (from a supervisor or a customer) and at the same time, it is an oportunity for the team
shows its current state of the project. During the course there are 4 Milestone meetings using IRC tool to carry out them and the corresponding report of each one.

3. TEAMWORK

Last year, 9 teams were working in Runestone course. Each team contained from 6 to 8 members from Sweden and USA in the same team, or from Sweden and Finland or teams with members from the three countries. Working in an international team is a challenge for the students. The environment is different than a ordinary team and the students must look for the tools and methods to achieve a good communication and cohesion in the team.

The student must carry out a work in group getting that the team performs like a unit. In the professional practice the projects are usually executed in teams therefore learning to develop and move oneself within a project team is very important.

In Runestone course is looked for that students get the team works properly, in a harder environment where the group have several members (6-8) and the members are in different countries.

In the course is very assessed issue getting a suitable communication. The team must reflect that the team is close, the team works in concordance between the members, that they change knowledge and they help themselves to solve the problems, organize task properly, and there is a good social environment within the team.

The teams use online tools to communicate as video-conference, IRC, Marratech. In the Milestone reports, the students must reflect the dynamic and performance of the team. How they arrange the tasks, solve the problems, the participation of each member of the team, how make decisions, how manage the meetings, how the exchange information.
Chapter 3

Teachers: the intention

3.1. Data collection and analysis

The thesis has studied the Runestone course from the viewpoint of teachers. They design the course defining the motive, the goals and the structure. Each year they work to incorporate improvements based in the experience of last instances of the course.

For the interviews were used IRC sessions. The teachers that participed in the thesis from the three different countries of Runestonce course are:

Arnold N. Pears, Uppsala University (Sweden). His responses are indicated by the letter A.
Robert Adams, Grand Valley State University (USA). His responses are indicated by the letter R.
Seppo Virtanen, University of Turku (Finland). His responses are indicated by the letter S.

The interviews with teachers are structured nine blocks of topics that have been considered like interesting such as was explained in the section 1.5:

- Motivation and objetives of Runestone course
- Step from University to professional practice
- Three direction teaching: technical skills, management and teamwork
- Methods and tools for teaching in the course
- Innovation vs traditional teaching
3.1.1. MOTIVATIONS AND OBJECTIVES

Motivation is the spirit nature of the course, the basic fundaments and the philosophy that will mark all aspects around the course.

Motivations are an essential aspect. The motivations are the intentions, the set of motives that move to run a project, the factors that manage an objective. Defining the motivations is very important because they are the key to indicate the reason and the patch which a project is proposed.

Teachers of Runestone course identify different motivations to teach and carry out the course. In some motivations they coincide:

- All coincide with stating that a main motivation is that students work in an multi-cultural project, with international relations and using online methods of communication.

- Other motivation that they explain is the opportunity of putting in practice in a long project some theorical concepts that students learnt in earlier courses.

- But also there are different approach. While some opinions are declared totally ‘student-centred’, other opinions add as well as motivations focused in students, motivations as a teacher, the commitment and responsibility to provide an education towards the professional practice for the future of the students, responsibility also required by Swedish law.

Q: What are your motivations to teach and carry out the Runestone Project Course?

R:
<@adams> The motivation me is student-centered -- I think the students get a valuable and unique experience in the Runestone project that they would not otherwise get in a non-collaborative project.  
<@adams> Specifically, the experience with working on a virtual, cross-cultural team.

S:
<@Seppo_Virtanen> OK. The course is intended for 4th-5th year
students here
<@Seppo_Virtanen> and the title locally is "Advanced Networking for Embedded Systems".
<@Seppo_Virtanen> The course is run mostly as a project course
<@Seppo_Virtanen> There is one introductory lecture
<@Seppo_Virtanen> And usually one summary session afterwards
<@Seppo_Virtanen> The goals are to teach the students to work in an international design project
<@Seppo_Virtanen> using the skills they have learned in earlier courses
<@Seppo_Virtanen> like programming and network technologies
<@Seppo_Virtanen> The participants hopefully learn to understand the kinds of issues

A:
<arnoldp> My motivations are partly personal, I became good friends with the first teacher at GVSU that I taught with (Carl Erickson) and also with Robert (whom I have also met quite a bit). Seppo and Dan I have not met as often in person
<arnoldp> In terms of learning and motivations for this type of course, there are a number of factors. One is that we are required by Swedish law to provide students with an education that makes them employable and which gives them a perspective on what their life as a professional in the workplace will be like.
<arnoldp> I believe firmly that students need to put into practice theory, and also have a chance to practice work skills that are not 100% technical in nature.

- **Q: what are the objectives, the intention of Runestone Course?**

R:
<@adams> There are two. The first, I just mentioned -- learning teamwork, communication, professionalism skills.
<@adams> The second (and this is solely for GV students), this is their senior project, so it is the final design/development experience in their academic careers.
<@adams> The objective is to give them an opportunity to "show off".
<@adams> To give them huge open-ended project and let them explore the research, design, and development without close instructor supervision.

GVSU students had an additional objective, the Runestone course is their senior project of the degree unlike Swedish and Finnish students.
3.1.2. ARE STUDENTS PREPARED TO FACE UP PROFESSIONAL WORK?

The teachers in Runestone emphasize that the main problems are not in technical aspects precisely. They notice some problems in the following issues:

- In professional life, work is almost always integrated in a group, therefore is basic to be able to work with others and get a fluent and trust communication.

- Also, in the current days, the technology gets to eliminate distances in the world and projects are often carried out by persons from different places and collaborations from different countries in a very usual way. So, professionals in Computer Science must be able to cope with these situations and learn how to work in projects within different cultures involved.

- The culture in Industry is different than culture in University. The problems usually are very fuzzy and they require ability to make decisions. Also companies used theirs own tools and professional must be able to adapt them and learn continuously.

- In professional practice is very important to have ability to adapt to the changes.

- \( Q: \) What do you think are the main problems that students face up in professional work and which maybe they are not prepared?

R:

@adams> Cooperating with others, coming to a consensus about how to accomplish a task.
@adams> Being able to communicate ideas in written and oral form.
@adams> Time estimation.
@adams> I think that's it. Our students don't struggle too much with the technical stuff. They are generally technically competent.
@adams> I think students need to understand that they don't simply work in a cave by themselves.
@adams> They work in an environment engaged with others for most of the day.
@adams> Certainly during job interviews, we hear of students struggling with the "soft" skills more so than the hard technical skills they learn in class. The feedback I hear from students is that Runestone gives them an opportunity to explore their soft skills in an educational environment.

S:

@Seppo_Virtanen> In general, it may surprise them that in
their work place they still need additional training for in-house practices
<@Seppo_Virtanen> They have learned a lot of things in theory and in practice, but companies may use different tools and obviously have a somewhat different work culture than the universities.
<@Seppo_Virtanen> Of course it also depends on whether the position at work is very close to the students' acquired expertise
<@Seppo_Virtanen> If you have focused on embedded systems hardware, and need to start working with embedded software, there are of course quite a few challenges and new things to learn.
<@Seppo_Virtanen> In the end, it depends on the person
<@Seppo_Virtanen> But courses like Runestone sure help them understand the kinds of practical challenges they may face

A:
<arnoldp> In my work I collaborate a lot with people overseas, and from other cultures, getting an understanding of this way to work is increasingly important as a modern professional skill, I believe.
<arnoldp> Students in most courses have very well defined problems to work with, this teaches them that all problems are solvable in the time available, and that they often are not given information that is non-central to the task to be accomplished. Runestone provides a more open type of problem, where choices have to be made, and what is delivered is negotiated with the teacher, and tailored to the team (on the basis of preferences and techni

3.1.3. THREE DIRECTION TEACHING: SKILLS IN TECHNICAL, TEAMWORK, MANAGEMENT

The course is based in three main axes:

Teamwork
Management
Technical aspects
As teachers marked in their motivations for the course, Runestone expects encourage to students to have a more global vision of long projects and realize that aspects as teamwork and management are so important as technical issues. Students normally are very comfortable with the technical parts because they are widely trained during the degree.

The course is focused in learning of these three materias. Actually the assessment of work about teamwork and management in the course has so value as the technical aspect. Teamwork represents 30% of the final score, management 30% and technical aspects 40%.

Teachers describe why is so important in the professional life each part which are structured the course:

- Working in long projects, skills about management and team are very important. The great majority of times, projects are in group. These works require a solid ability to organizations, definition of methodology, planifications of resources (as time, number of persons, money, etc), teams with structuration, work in equilibrate collaboration, constant measuring about the current state of the work and reaction in view of potential problems. Choosing suitable tools is a significant aspect that the team must decide and they will mark all way in a project.

- The aspects outside technical area usually are underestimated by technical students. They does not attach importance to how organize and manage the team. As one teacher says, the course gives the opportunity to students to notice which are their soft abilities in the whole project. Teachers mention that the student must take the initiative by himself/herself to stand out from the aspects which they realize that need to improve. For example, in the course the election of leaders of each team is a voluntary choice. This role in the team gives to students that they wish, the opportunity to take activities of team responsability and manage. Occasionally, it could mean more load of work for them, but in compensation they can experience and learn in this field. Therefore, the attitude and initiative of the student will mark the own learning in the course.

- The students can experience the work in an international team. That means they must hand the cultural differences as learning of the other team
mates of other countries and enrich their knowledge as to solve friendly the possible conflicts that the international differences could generate.

- Technically students can apply knowledge of previous courses like Software Engineering, of which theory is very present in the course and is putting in practice.

- Runestone course tries to give students the opportunity to experience themselves in areas that maybe they are not used to hand and learn from their failures at University, as a teacher explains. Learning from the unsuccessful thing is an excellent way to reflect on what works wrong and revise the consequences of the errors. The students can grow professionally learning of the failure and get from it positive conclusions.

Therefore, Runestone course is a chance for teacher to see how students work in each one of the three areas and observe the consequences of the outcome.

- Q: The project course is structured in 3 parts: teamwork, management and technical. Why do you think is important to learn about these 3 parts?

  R:
  <@adams> Because the represent the three pieces of any project. Working with a team, managing the project and making sure it moves forward, and making sure that the project meets its technical requirements.
  <PATRICIA_SWEDEN> how do you mean the concept of management in a project for students?
  <PATRICIA_SWEDEN> I mean, what are the skills about management that Runestone course gave the students?
  <@adams> The students must choose an appropriate development methodology, plan for milestones, assess whether or not they are on track and adjust their pace of development if necessary.
  <@adams> Choosing appropriate development tools.

  S:
  <@Seppo_Virtanen> In actual working life you need to understand all three areas
  <@Seppo_Virtanen> unless you are happy to be just a programmer who gets "orders" from higher management
  <PATRICIA_UPPSAL> yes, nowadays most of cases the professional work is inside a group
  <@Seppo_Virtanen> Yes, and of course we hope that our students would have management and project working skills in their work life after they graduate.
  <PATRICIA_UPPSAL> about these 3 parts: teamwork, management and technical
What skills do you think Runestone Course gave students?

I think everyone got some of the skills. Some perhaps focused most on technical whereas some got more on management and teamwork. Since the project starts from zero and the groups need to self-form, I think each member gets a nice opportunity to grow in the area they need most improvement in or are most interested in.

Technical: understanding of the different areas of the project

Groupwork: learning to take into account cultural differences in ways the participants in different countries communicate, learning to work in a way that allows other group members to easily see what changes have been made, etc.

Management: working with timezones, work allocation to team members, reporting, acting as a team leader for some participants, ...

A:

I try to create an environment in Runestone where students can experience failure. This is a valuable lesson to be able to learn while still at University. When did you have too much confidence in your ability, when did you overestimate the predictability of the task, when did you rely too much on things going as expected? People learn a lot from failing, and then reflecting over why they did not succeed as they had hoped. This is one

Teamwork is another important skill, and the importance of teamwork and communication is underestimated by many technical students.

The focus on these three areas is an attempt to reward students spending time on gaining experience in those areas. A way of showing that I think that they are valuable, and that I will try to see what is happening in each of these aspects in the team, and then give feedback and even a performance grade.

The technical aspect is still important, even though the main focus in the course is on applying management principles and working on team based problem solving. The technical task is directly related to the two courses that lead up to this course, so the students are able to put into practice a lot of the theory they have studied in the term before.

This also helps them to realise the weaknesses they might have in some areas when they try to develop larger
software systems that are distributed and communication based.

<@PATRICIA_UPPSAL> and what do you mean about management exactly in the course?

<arnoldp> Management is about the way in which the team coordinates its actions and takes decisions.

<arnoldp> Sometimes the management structure of a team is very unclear, so this provides a chance to discuss what effects that might have on the final outcome. Clear communication, ways to record and follow up on decisions, how to take decisions without creating bad feeling. All these skills are something we can spend some time on.

<arnoldp> I think that many of the participants in the course underestimate the value of management and the relationship between clear management and goals and successful teamwork.

3.1.4. RESOURCES USED: METHODS AND TOOLS OF TEACHING IN THE COURSE

The teachers are asked about the methods and tools that they have used in Runestonce course, methods and tools focused to create an environment similar to professional environment.

-One teacher explains that he does not think the Runestone’s environments is similar to an environment of real work because he associates this environment with offices, infrastructures and physical environment. But he declares that referred to teamwork and management, Runestone is similar.

-Related to the methodology, there are different opinions. One teacher states that the philosophy of the course is giving students an open-ended problem where instructors provide general specifications, a litte directions and students must find out the way to solve the problem and get the outcome. The idea is that each team creates itself and manages by itself the progress of the project with a soft support of teachers. Other teacher agrees with it, but he suggests to provide a more restrictive conditions in next instances of the course, because in the Industry, the used tools are usually established by the company and the professional in computing must adapt to them and work in this way.

-Related to the tools in Runestone course, working in international teams, the online tools for communication are essential. Students are free to look for tools to communicate with their team mates in other countries using for example IRC, video conferences, etc for their internal meetings. On the other hand, there are bi-weekly Milestone meetings between the instructor and the team that simulate meeting with clients, using IRC. For the final presentation of the implemented work, teachers provide the Marratech virtual meeting connecting instructors and teams from the countries involved.
Teachers provide a wiki system, a web site that can be edited by multiple persons through the web browser. The users can edit, modify, delete a same text that they share. Also, teachers provide SVC, a system for the control of versions. It manages changes in the folders and files to visualize modifications and get backups. Also, due to the system works over Internet, several persons can work in the same file in a collaboration way. For internal work between teachers, a Google spreadsheets are used.

- *Q: What were the used methods and tools to create an environment similar a real work environment?*

  **R:**
  
  @@adams> I suppose the method was to give the students an open-ended problem without a clear path for design or development.
  
  @@adams> We had bi-weekly milestone meetings (simulating meeting with the clients) where the teams had to present their work to date.
  
  @@adams> A final project presentation was done where students told us about their final implementation.
  
  @@adams> There is very little direct teaching going on. Rather, the experience itself is a pedagogical one.
  
  @@adams> So in summary, the methodology is one of a hands-off project where the development team is given a vague idea of what is required, and they have to figure out how to get to the end.
  
  @@adams> As far as tools are concerned, the virtual team aspect means that we use online tools exclusively (the students can't meet in a meeting room each week).
  
  @@adams> We have a collaborative wiki system where the students can post questions, answers, documents, whatever they want.
  
  @@adams> We provide Subversion for version control.
  
  @@adams> I know some teams used irc, video chat, and IM to conduct on-line team meetings. However, I'm not sure I would say we "provided" this for them. Nowadays, students are sophisticated enough to know how these work without being told.
  
  @@adams> We provided a Marratech virtual meeting room for the final presentation.
  
  @@adams> We instructors used a Google spreadsheet to record grades. That is MUCH nicer than when Arnold and I used to share an Excel spreadsheet and had to mail it back and forth.

  **S:**
  
  @@Seppo_Virtanen> I can't really say that we would have been able to create an environment similar to a real work environment.
  
  @@Seppo_Virtanen> A real work environment would consist of
offices for the people working in the project and much infrastructure.

<@Seppo_Virtanen> We have one small labroom
<@Seppo_Virtanen> With one computer for testing the programs and server features
<@Seppo_Virtanen> This room is shared by all teams with local participants (this year 2 teams)
<@Seppo_Virtanen> We had a robot kit for each team
<@Seppo_Virtanen> Also, since many of the participants actually had dayjobs here
<@Seppo_Virtanen> They mostly worked with their own computers, not the lab computer.
<@Seppo_Virtanen> So, the similarities to work life were in my opinion locally not so much in the infrastructure but more in the teamwork and management part.

A:
<arnoldp> We provide a server that hosts the code development and provides a wiki for managing information related to the project. We also provide source code control using SVN on the same server.
<arnoldp> The idea has been to give students a set of tools, both technical and communication and to let them explore how to communicate. In some ways this is not similar to an industry situation, where tools are often purchased by the company and must be used.
<arnoldp> We have also allowed the students to use their own solutions for code management etc. This is also not very like industry practice. One area of the project course that we might change in the future is this aspect. I think it would be useful for the students to experience working in a more restrictive environment with specified communication and source control systems and also coding standards.
<arnoldp> Better than getting into a conflict in the first job ;-) 
<arnoldp> So that is tools...
<arnoldp> We do specify IRC for milestone meetings where we meet as (instructors/clients) with the students. But internal communication in the group can be done with any tools they like.
<arnoldp> Actually we should probably penalise people for using off-site code repositories. That is definitely a thing that would not be acceptable in industry.
3.1.5. INNOVATION vs TRADITIONAL TEACHING

- Some teacher’s viewpoints state that the most important innovation of Runestone course is the methodology itself of the course, working in an abstract project where to a large extent, students must take sides and must be very enterprising and all staff involved in international collaboration. Moreover other answers explain the advantages of tools used in the course, like Wiki tool as a log and information source both teachers and students. And the possibility of work with other students in other countries using online communication instead of traditional communication. Other relevant aspect of Runestone course related to innovations is explained by Arnold, who states that the assessment is a strong point. ‘We are focusing a lot on trying to assess teamwork and process goals using qualitative descriptions of levels of outcome required for particular grades’ declares Arnold.

- Other question during the interview was their opinions about the needs of introducing innovations in teaching in Computer Science degree. All teachers agree it is necessary. The best way to teach aspects like management and teamwork is putting them in practice, to get that the students experiment with these practices at University. On the other hand, Computer Science is a subject that evolves and develops very quick. Nowadays, the IT technologies undergoes changes continuously and professionals in computing must aware. Teachers must involve in this characteristic, to be up to date and exchange opinions with mates and students. ‘Recognising that we are all learning’ says Arnold.

S:
@@Seppo_Virtanen> First of all, the shared Wiki system is very useful.
@@Seppo_Virtanen> The instructors can provide technical documentation and instructions there
@@Seppo_Virtanen> And also act as upper management for the students, providing timetables for meetings
@@Seppo_Virtanen> and a schedule for delivering progress reports.
@@Seppo_Virtanen> It also acts as a log of things that have taken place during the course.
@@Seppo_Virtanen> For the students, it provides an information bank for everything they need to work with during the course,
@@Seppo_Virtanen> a means for communicating with each other
@@Seppo_Virtanen> a means for storing and version-controlling their software
@@Seppo_Virtanen> the use of free online tools for organizing meetings is very good.
@@Seppo_Virtanen> It successfully simulates corporate ICT
technologies, although of course is not as flexible.

Skype vs. cell phones, IRC vs. conference calls etc.)

And the possibility of live interaction with students in other countries and cultures.

I think these are the biggest innovations or at least new practices the course provides compared to a more traditional project course.

Do you think is necessary to introduce teaching innovations in teaching of Computer Science?

Yes

It seems that at least in Finland the resources (i.e. money) available for teaching courses is more and more scarce.

New innovations may provide a platform for maintaining and even improving the quality of teaching while reducing teacher load and thus saving money...

The major innovations are not really new anymore, open ended project work and ill structured problem solving are becoming more mainstream. Problem based learning is also a related technique, though quite often the problems are much more carefully manged and smaller in scale I think.

When we began the course in about 1997 we were very innovative. Now the world is catching up and we are more normal I think. We are still quite unique in the format and the assessment, as well as the international involvement aspects. This is really something we should document more fully I guess.

One area where we are quite innovative still also is the assessment. We are focusing a lot on trying to assess teamwork and process goals using qualitative descriptions of levels of outcome required for particular grades.

And in general

Do you think is necessary to introduce teaching innovations in teaching of Computer Science?

Much of computer science lacks a feeling of relevance to many young people today I think.

In that sense, yes, we need innovation

I also think that the large number of lectures we have in many CS courses is too old fashioned, and we might do well to engage more in a dialogue with our students and colleagues. Recognising that we are all learning, and that the collaboration around learning is one of the things that makes education fun.

Finally, some aims cannot be easily achieved by a traditional teaching model.

For example teamwork is hard to learn just as a
theory, it is better to have some experiences as well that help to create an intuition
<arnoldp> Active and aware of the intent and goals of the course.

R:
<PATRICIA_SWEDEN> Do you think is necessary to introduce teaching innovations in teaching of Computer Science?
<@adams> I assume by "innovations" you mean something other than classic lecture or lecture+lab.
<PATRICIA_SWEDEN> exactly
<PATRICIA_SWEDEN> different of traditional methods in the University
<@adams> Then yes, I think innovative teaching practices are essential. I'm not sure how one can teach teamwork without allowing students to work in teams.
<@adams> The same is true for "teaching" students how to handle open-ended projects.
<@adams> We can give them some rubrics, but nothing beats actually doing it themselves.

3.1.6. DEVELOPMENT OF CREATIVITY TO STIMULATE STUDENTS

The creativity is an aspect that helps to students to grow in their education and self-confidence. The development of creativity and talent in the technical education is more and more present in the pedagogic process of learning.

For professional practice in computing is very useful to encourage to students to improve their creativity during the University, they must learn to find out new ways of response and solution, innovation, anticipation, ingenuity in the individual and collective work of a professional in computing.

When teachers are asked about techniques in the course that support the development of creativity in students, they notice the following techniques:

- the abstract and open problem that define the project itself is a way of boosting the creativity of students, since they have a long freedom to develop all aspects of the project. If students find a project with different characteristics which they can innovate and manage, it instil their creativity.

- other teacher sees in the structure of different roles in the team managed by a leader a way of creativity. It gives students the opportunity to be independent as a team. Managed by the leader, the team takes their own decisions, favoring creative and resourceful teams.
- the best way of be creative is being motivate with interesting challanges. In the case of American students, this course is their senior project. They are encourage to use new tools and do their best.

- Q: What could be, in your opinion, techniques that support the development of the creativity to stimulate students to find out themselves new relations between the concepts in accordance with the offered tasks?

R:
<@adams> First, I think the fact that the problem we give them is unfamiliar and large means they must act creatively. It is not the case that students can simply do what they learned in class. Typically, course assignments are narrowly focused to highlight a particular topic. The Runestone problem isn't like that.
<@adams> Second, I specifically tell my students that I encourage them to try out techniques and methodologies they've only heard of.
<@adams> I really to motivate them my telling them the project is their senior project. It should be the best work they've ever done. It is also an opportunity to learn new things on their own.
<@adams> I think most of my students buy into this and really try to do their best.

S:
<@Seppo_Virtanen> I think a project course where one of the students has to be a team leader is one such technique:
<@Seppo_Virtanen> this is a signal to the team that since one team member is leading the team, they have to assume a more independent role as a team
<@Seppo_Virtanen> Since one of the students is the boss, the threshold to just ask the instructor without trying to find out about things themselves is higher
<@Seppo_Virtanen> And this in my opinion could be seen as a stimulating factor to encourage a more creative way of thinking about the issues dealt with in the course.

A:
<arnoldp> If people understand the purpose of learning situation and what is to be achieved things are a lot easier for everyone and more gets done/achieved
<arnoldp> For me, much of this is about being excited and supportive
<arnoldp> As well as creating a situation where there are challenges and real rewards, both in terms of assessment and
I see my role as being to try to give each individual an opportunity to their best and to learn what they feel is interesting. Part of the difficulty is that everyone has different levels of knowledge, even if they have been at the same Uni in the same courses all the time. This makes it hard sometimes to give people the right types of incentives to achieve.

I guess that creativity is also inspired by interesting and relevant problems. People are more creative also when you give them more freedom to decide themselves on how the solution should be.

That seems like all I have on that topic I guess.

3.1.7. INTERNATIONAL COLLABORATION AND CULTURAL DIFFERENCES: RUNESTONE COURSE, INVOLVED DIFFERENT COUNTRIES AND UNIVERSITIES

One of the main characteristic of Runestone course is that involves 3 different countries:

- Uppsala University, Sweden
- University of Turku, Finland
- Grand Valley State University, Michigan, USA
- Rose – Hulman, Indiana, USA

The teams normally consist of members of two countries: Sweden & USA or Sweden & Finland although sometimes teams consisted of members of the three countries at the same time.

Nowadays, we live in a very global world and the distances using technology are shorter. In the IT industry is usual work in collaboration with mates from other countries. Therefore this feature of Runestone course gives the student the opportunity of experiment how work in an international team, exploring their weakness in this aspect and learning to asses the advantages to enrich with knowkldege of other countries.

So, working in international teams, students can face up with difficulties due to cultural differences, they can realize the advantages to work in a multicultural environment and acquired skills in this aspect. All these things were asked to the teachers.

As difficulties they state problems like differences in timezones, language, etc. But the main problems can arise about how the work is focused by both parts of the team, many time there are different views and also is complicate the control of the progress of the work and estimate properly the time. Cultural differents
can mean difficult to understand in the group behind the words. Seppo explains, ‘There are surprisingly many small but significant cultural differences between the three participating countries. Even between Finland and Sweden. (...), but in my opinion it is one of the things to be learned during the course. At the end of the course the Finnish students should understand the differences in communicating with other Finns as compared to communicating with Swedes or Americans.’

One teacher explain different in the technical knowledge because American and Swedish are students of different courses. Robert says, ‘GV students are in their final term, in theory, they've learned everything there is to learn. UU students are in their 3rd year (I think).’

But saving the difficulties, working in different countries gives several advantages and skills that students can get. Different viewpoints also are a positive aspect that contribute to enrich the team. Learning different styles to lead a group. And exchange technical knowledge.

A very important aspect is that difficulties are also for teachers. Organize a course of these characteristics collaborating several countries is not easy. The trust is crucial to carry out the course.

- Q: Runestone course is a really ambitious project because is involved in different Countries and Universities, what do you think are the main difficulties, the main advantages and the most important skills acquired by students working in an international work group?

R:
<<@adams>> Difficulties: Leadership styles -- how to resolve conflicts within the team. How to handle the differences in time zones.
<<@adams>> Sometimes (rarely) language is an issue. However I think this has more to do with the nature of text-based chat. Things like sarcasm don't come across with text chat.
<<@adams>> Advantages: Learning how different cultures react to issues like stress, conflict, etc.
<<@adams>> Skills: Learning what each student's particular leadership style is. I think this can only be learned by being in a team for a long time.
<<@adams>> The struggle my students have is that of the differences in technical abilities between the GV and UU students.
<<@adams>> GV students are in their final term, in theory, they've learned everything there is to learn. UU students are in their 3rd year (I think).
<<@adams>> Many GV students feel like they have to hand-hold the UU students.
<<@adams>> It's not that they feel the UU students are incapable, they just haven't had all their classes yet.
S:

<@Seppo_Virtanen> Difficulties: dealing with timezones, allocating work to each location in a functional way, dealing with unmotivated participants if there are any. Cases, where there are two team members at one location and one of them decides to quit the course (students can do this much easier than employees).

<@Seppo_Virtanen> Advantages: learning practices for working in an international team where team members are geographically apart - learning in practice how things like time zone differences need to be taken into account

<@Seppo_Virtanen> Learning to identify own strengths in task allocations in the teams as compared to others

<@Seppo_Virtanen> Learning to communicate with other team members in a way that others do not find offending.

<@Seppo_Virtanen> There are surprisingly many small but significant cultural differences between the three participating countries. Even between Finland and Sweden.

<@Seppo_Virtanen> I guess that was to the last two parts of the question (advantages and skills).

<@Seppo_Virtanen> Of course they learn technical skills, too

<@Seppo_Virtanen> Programming, ICTs, code versioning

<@Seppo_Virtanen> Some may know some of the stuff beforehand, and others may find the same things new and need to learn them.

<PATRICIA_UPPSAL> do you think these significant cultural differences in an international group could they make harder the communication of the group?

<@Seppo_Virtanen> Perhaps initially, but in my opinion it is one of the things to be learned during the course. At the end of the course the Finnish students should understand the differences in communicating with other Finns as compared to communicating with Swedes or Americans.

A:

<arnoldp> the difficulties are not just for the students.

<@PATRICIA_UPPSAL> and how are them for teachers too?

<arnoldp> We staff also have to collaborate and negotiate and mange the course, this is not always easy. In some situations in the past lack of trust has really caused crisis situations to arise. Now we work with quite a high level or trust and that makes things much easier.

<arnoldp> For the students then

<arnoldp> The major difficulty is the teamwork and tracking development progress.

<arnoldp> Most teams have more than enough technical competence to be able to build a good system.

<arnoldp> Most teams don't specify the design in enough detail,
and then as a result of being too ambitious with technical aspects, they leave the integration of subsystems until too late.  
<arnoldp> This situation is due to a number of things, communication between cultures, and not really understanding what people mean (behind the words).  
<arnoldp> That is one big part of it.  
<arnoldp> Another part is that many participants don't know how long it takes to integrate and debug large systems. This is something that nearly all teams underestimate and the result is an unstable system at the final presentation (as you observed yourself in many teams this year)  
<arnoldp> Understanding that cultures are hard to get a grip on, even if the language seems clear enough.  
<arnoldp> There are a number of valuable time management and coordination skills that many (perhaps not all, but many) of the participants learn to think more about. Or at least to realise that they didn't know as much as they thought, and it was not as simple to do as they expected.  
<arnoldp> There is also an advantage of doing some low level network programming. Java sockets don't require the programmer to think about packet format much. Object serialization does that for you. When the teams program the NXT brick there is no serialization support in the limited Java on that hardware. This means that they suddenly realise the value of knowing the length of the packet and exactly how each field is represented and packed int  
<arnoldp> So that is a technical aspect of one of the other courses that gets a nice re-inforcement through the project.

3.1.8 COMMUNICATION IN THE TEAM

Communication is basic for the good work of a team. The communication depends to a long extent the outcome of the project. It can be assessed how the communication affect to the final results. A suitable communication has been an aspect very observed by the teachers in the team.

• **Q: Getting a suitable communication in the work groups has been a very assessed issue in the course? Why is so important a suitable communication to get success in a work group?**

A:

<arnoldp> Communication (I think) is vital to a successful collaboration

<arnoldp> Learning to communicate enough so that people don't feel isolated or ignored is important.

<arnoldp> Being able to coordinate and ask for things in a way that encourages rather than creating offense and problems is also a valuable skill.
3.1.9. ASSESSMENT OF RESULTS

The assessment of the course by the teachers is very positive. Teachers think students in general reach the objectives of the course. They assess that after the course, the students reinforce their technical skills and improve not technical skills.

- Although some problems are detected. Problems in the estimation of time. Some of them were very convinced and working in a large project requires a very good organization in the time of the work. Probably due to lack of experience, as Robert explains.

- Arnold emphasizes that students must be prepared to be competitive in Europe.

  • Q: What is your opinion about the results of the project? What is your assessment about the course results?

R:
<@adams> On the three dimensions you mentioned above...
<@adams> Management: I think most teams manage their teams and the project quite well. Sometimes they fall a bit behind, due to a lack of experience in time estimation. All in all, they do fine.
<@adams> Teamwork: Rarely do we find serious teamwork issues. Most teams struggle a bit at the beginning trying to figure out how to divide the work, but then most work well.
<@adams> Technical: Most teams are successful in that they accomplish the minimum requirements we set for them. Few teams go beyond that and really "Wow" us. However, I wouldn't expect every team to be a "A" team.
<@adams> So in summary, I think most teams do what we ask.

A:
<arnoldp> There is a lot of value in understanding how hard this all is. Many people who are IT project managers have programmers around the whole world. This is increasingly true of all large and some small corporations. Our graduates need these skills in order to be competitive in the European workplace.
<arnoldp> I think that the course has been valuable for nearly everyone who has taken it.
<arnoldp> This year the teams were more even in performance and also had better products than in many prior years. However, I am not sure that this is a measure of success, since much of learning comes from failing (as I said at the start).
<arnoldp> Despite that thought I am happy with this year's course. One thing is that the collaboration with Dan and Rose Hulman does not seem to work as smoothly as with the other sites, both at the student and instructor level. We might
need to sit down and have a think about that aspect of the course.
<arnoldp> Other than that, I am very satisfied with the course now, and I think that the changes we have made over the years since 1999 have made it much better, and allowed us to be much clearer about what we are trying to teach and how to assess if participants are getting the types of experiences we want them to have and gaining knowledge from that.

S:
<@Seppo_Virtanen> The results are good
<@Seppo_Virtanen> the students learn a lot
<@Seppo_Virtanen> and enjoy the course
<@Seppo_Virtanen> Also in terms of teacher effort in comparison to a traditional lecture course
<@Seppo_Virtanen> Instructor load is less.
Chapter 4

Students: the experience results

4.1. Data collection and analysis

The thesis also has studied the Runestone course from the viewpoint of students since they are the reflection of the consequences and results of the course.

In the thesis students have been classified by nationality. At the beginning, several criterions were considered: performance, gender, nationality and background. Gender was not chosen because last year in the course, only one student was woman. It was not a very balanced criterion of classification. Sorted by nationality looked a good criterion. Of the eleven students to agree to be polled, seven of them were from Sweden, three of them were from USA and one of them was from Finland. The classification by background coincided practically with the division by nationality because the Swedish students were third or fourth year students on the IT-programme, American students were in their last year of the degree of Computer Science and Finnish student was in his fifth year. Therefore finally nationality was chosen as criterion to classify the students in three groups: Swedish students (labelled as S1-S7), American students (labelled as A1-A3) and Finnish students (labelled as F).

From the viewpoint of students of Runestone course, the study of the thesis has been centred in seven main aspects. The fundamental questions are related to this classification topics:
Motivation to study Runestone course
Step from University to professional practice
Acquired skills during the course
Methods and tools used in the course by students
Work in team
International project
Results

4.1.1. MOTIVATIONS TO STUDY RUNESTONE COURSE

Q: What are your motivations to study and carry out the Runestone Project Course?

The students express two different groups of motivations to carry out the course:

- It is a mandatory course
- The special environment which the course is presented. The opportunity to be near Industrial context, take own decisions, be creative and work in an international team

The opinions are very similar between the students of the 3 countries:

1. It is a mandatory course:
   Some students indicate this reason as the unique motivation for the course. Two students says:
   
   S4: Since it is part of the program I am in I pretty much have to
   S7: I study the IT-program at Uppsala University so this course is non-optional for me.

2. Special environment which the course is presented.

Other students state the opportunity to be near Industrial context, take own decisions, be creative and work in an international context:

S1: Well... the course is mandatory after all... so there is no getting away from that. But personally I felt motivated by the scope of the course, the international setting and opportunity to practice teamwork in a near-business like environment

S2: The whole project was a fun idea and for one of the first times the course was selfmotivating and not having alot of help by teachers, I think, was encouraging to search for own answers
S3: To experience “real life” work and working with people from other
countries and understand the limits that can arise because of group dynamics
and when co-operating with other cultures.

S6: that there is room for being creative

A1: I was motivated by me being given an opportunity to learn new concepts and
to see my years of hard work in college being used.

F: well, it sounded like an interesting course on software development and the
collaboration with other universities was a nice extra too.

4.1.2. STEP FROM UNIVERSITY TO PROFESSIONAL PRACTICE

Q: What do you think are the main problems that students face up in
professional work and which maybe they are not prepared?

Many technical students recognize fear of the moment of their incorporation to
professional practice after the University.

S2: (...) im a bit scared for later when I go out to make a career and not beeing
able to stand on my legs.

S6: I think most students will have problems facing that working in real life
doesn't always mean do a good product, management, economics. things in that
nature

They usually feel enough prepared in techical skills but they are not so sure
about other required skills at Industry. In this study, when they are asked, the
answers can be divided in the following categories:

- Find the customer requirements
- Leadership and organization of team
- Education has not ‘real-world problems’
- The tools that companies use

1. Find the customer requirements:

Some students think that to define real problems is a hard task. They do not feel
prepared to deal with the customer and capture the requirements of the software.

S1: But I think that dealing with customers and finding out the requirements of
the customer are one thing that's missing... considering how many of our
students will end up as consultants - that part is really necessary.
2. Leadership and organization of team:

Other problem identified by students is the training about how lead a teamwork and work in a team professionally.

F: the process itself as a whole, management, bug tracking and customer contacts/requirements. In a school project you can do it all by yourself find a bug, search for it, fix it. Nothing is then stored in the record. In professional work it is important to have everything saved somewhere also the management is usually in a school project very loose.

S1: (...) also leadership and organisation of teamwork learning how to take charge and to push the group forward today those skills are only acquired by the students who take initiative themselves...

S3: Leading work (as team leaders did in Runestone), writing and speaking in front of other people.

3. Education usually has not ‘real-world problems’

S2: (...) I think the educational stuff we doesn't contain any "real-world" problems(...) but in the same time it would be hard to incorporate that kind of "problems" into the education because first we need to learn how we do stuff, theoretically, and then implement them in a project of some sort(...) to answer the q: as of now i dont think im prepared to go out and make a career

S7: Solving real problems in real projects. We have a lot of problem solving but always in limited environments. Rarely open-ended projects with people you may now know.

4. The tools that companies use

A2: The tools that companies use to do the software development. In example, the source control, IDEs, and compilers.

4.1.3. ACQUIRED SKILLS DURING THE COURSE

- technical skills
- professional skills
- management

Answers are classified in three parts:

- technical skills
S1: it depends on what parts of the project that you were on, but I think everyone got more familiar with for example Java and tools for software development like repositories I learned a lot about building interfaces and communications programming

S4: At one point we had to integrate parts of the program, and we found out we had to redo much of it because the versions didn't match (...) And I learned how to use the internet better. Both as a source for programming knowledge and free code.

- professional skills

A3: Communication skills. Especially in an international setting.

S4: Apart from a massive increase in programming skill, I think I learned how to react and adapt to problems we faced along the way I felt that as a group we faced a lot of problems but we planned well and made everything work in the allotted time

S6: But there was definitely potential to learn social skills

S4: I absolutely felt stimulated by the course. I learned that it is very important to keep up to date with what the others are doing and that versioning is immensely important. Teamwork is mostly people skills so I think that is something you cannot teach. But perhaps I learned how to "find my place" within a group, and how to recognize my co-workers strengths and weaknesses.

- Management

A1: the greatest skill i attained was project Management (...) usually in school you're given set dates, set goals to achieve, and a professor to answer any question(...) with runestone, the project was broad, dates had to be set by our team based on the times the 8 of us were available and the professor were there to keep us on track and to help with certain situations, but most problems were solved through research

A2: I was the groups leader and I learned a lot about managing the team. Also how difficult it can be to motivate a person that is not that motivated. It was also difficult to meet when there is such a big time difference.

F: (...) But this course again showed the importance of documenting You just can't go coding and not document what has been done and what still needs to be done

S1: management, I think this is where I learned the most since I got the role of the teamleader I did a lot of organising and managing the people in the group - making sure that we were on track and also communicating with the customer
(Arnold). (...) also getting a slight taste of the responsibility that you have in case the project would fail

S4: this course was very different from most courses not only because you were working in a team but also because you had VERY much freedom they only gave us some loose guidelines and then we were on our own and then there was the cultural differens as well

4.1.4. METHODS AND TOOLS IN RUNESTONE COURSE

• Q: Compared to traditional courses in Computer Science, do you think Runestone course has teaching innovations, new practices? What are they?

All students agree that Runestone has different style, has innovations. They emphasize the following aspects:

- very open guidelines. Prepare to work without guidance

S1: It is different yes... the kind of frustrating environment: not really knowing what the requirements are and what is to be delivered. I think that's a good sample of how it is to work in a real software project

S2: yes it do bring new forms of education compared to the other courses (...)I think the project workform with semi-regular course because it keeps the deadline thinking that we students are used to and also giving us very much own workspace to develop the project along the loosely specified goals so without the milestone meeting i thing alot of ppl will not work in time

- time management between the different countries

A1: time management when working online, especially with team members from another country, you have to manage the time allotted as well as achieve set goals if not, then the entire project falls behind because the group is not working in unison

- the importance of the documentation

F: But this course again showed the importance of documenting You just can't go coding and not document what has been done and what still needs to be done

- It’s more “learning by doing” and not so much “listen and learning”
S5: You have to find the answers yourself.

A3: Students need to be prepared to take responsibility and work without guidance. Courses like Runestone is good for that.

- **Q:** Do you think is necessary to introduce teaching innovations in teaching of Computer Sciences?

A2: Yes, Computer Science is constantly evolving and if the teaching doesn’t keep up, how can a student be prepared?

Equally the questions for teachers, students are asked if the course encourages the creativity, how the students need to decide themselves and need to be creative in the development of the project.

- **Q:** Do you think that the course promote the creativity to stimulate students to find out themselves new relations between the concepts in accordance with the offered tasks?

A2: Yes I agree with this statement. It is critical to stimulate students and place them outside there comfort zone in order to teach them. Without this I don’t think the student can truly excel and show that they are ready for the “real” world.

S1: And the entire layout of the course, with practically no lectures... it is different. I think that depends on the student... and it's motivation... But sure, you need to work everything out yourself and there is a lot of things that you need to do research on but if you're lazy - you'll find it hard to find the energy to do that...as I think a lot of groups have realised

### 4.1.5. WORK IN A TEAM

In this thesis, the study of students in Runestone course is centred in how they worked in team. The outcome of the course of each team depends totally on the operation of the team. And we speak always of ‘team’ instead of ‘group’ because the different is that a team is a group of persons that join their abilities and knowledge to achieve a goals proposed. In Runestone course the teams have a special feature: each team is made up of students internationally distributed in different countries.

So how the students work in the team is close observed by the teachers and it is the key to study the experience results in the thesis.

So the topics about workteam that have been identified as interesting to elaborate the interview are the following:
After the course, students realize the importance of working properly as team. Working in group, there are different viewpoints, the members share knowledge, change opinions, help each other. It strengthens the commitment. The success of a team involves a suitable communication, a team with cohesion where all members involved in the same way, feeling of membership of team. All of them must collaborate to keep a social environment. The team must define rules of running as rules for meetings, objectives, organization and planification.

4.1.5.1. COMMUNICATION

The communication is a fundamental point for the operation of the team. The correct use of communication makes the process of development easier.

In the team, the members must take care day by day of the relation with the rest of the team to create an environment of safety and trust. It affects very positively in the atmosphere and the motivation of the team.

In Runestone course, the communication is more complex than an ordinary course because the members of the team are situated in different countries, so each team must develop the ability to get a suitable communication in this environment which is not possible to have physical meetings with some members of the team. So, students must act about factor of space with the aim to make easier the interaction. Also the communication in this course finds other different aspect: get a suitable understanding with people with different cultures.

So, students face up with special conditions around the communication that is a challenge to get success results. If the team do not get communicating properly, the final results show this fact. Runestone course tries to students realize the importance of communication in the development of a project in professional practice even in situations more difficult as inside an international team.

In this kind of team the communication is based in online methods. Students are asked about how they managed the communication in their team and how they get by using online communication to work. A key tool for the communication is the meetings.

After speaking with the students, the communication using meetings in the team is categorized, classified in 2 types:

- Regular meetings: between both countries. All members must be presented. This kind of meetings usually have informative nature. They
enable to make sure the correct process of the project, the members can ask and clarify their doubts. It is a powerful tool of communication. There are the opportunity to know and solve problems that may hold up the performance of the team.

- Informal encounters: brief meetings with nature informal and relaxed which members exchange information of work, coordinate actions, and so on. They usually are between members of the same country. This kind of meetings cause collaboration between the members of the team with behavior of help, suggestions, support of ideas, etc. In summary, they make easier the generation of ideas and the exchange of viewpoints.

**Q: What were the communication methods?**

Communicating in the team, students used video-conferences, chat sessions the forum available in the website of the course and electronic mail. Specifically they used tools like IRC or Google talk for group meetings, Messenger and Skype. Using the video, the communication can turn easier, as a student explains.

*S1: We used IRC for group meetings twice a week and we kept development blogs on the wiki for offline-communication. It took more effort though and I think we would have benefited from using video conferencing also in the earlier part of the project*

*S7: We used IRC for meetings and MSN for quick updates to individuals.*

*A1: we used irc to communicate with the sweden professor who was over our group, and us as a group used skype, it had video, so that was the main reason for skype*

- **Q: Do you think the communication is good only using online methods?**

In general, students agree in the communication is more complex without physical meeting, because using only online methods can reduce the level of trust and proximity in the contact with other mates but some students indicate an important advantage of online methods: all information of each meeting or communication with other member can be saved in a file, having in any time all information of a meeting to used later and the documentation of the meetings are much more easy and exact.

*S3: Yes – It’s good for documenting what was decided during meetings etc. If we would have used phone that wouldn’t be possible without recording and transcribing the calls.*

Also, other tools like Google code were used:

*A2: We used Google Code to hold the source code and track issues. We used Google Talk to hold meetings and communicate between team mates.*
Q: Getting a suitable communication in the work groups has been a very assessed issue in the course? Why is so important a suitable communication to get success in a work group?

S1: Well... because the problem was not well defined, we could not just start coding away each by ourselves... if the problem was to be solved using all the capacity of the group, an effective means of communication is essential. I know some teams divided themselves into subteams of swedes and americans for example... that will give you the benefit of not having to engage in too much communication but you will not really be working as a group you'll run the risk of having a person not performing their responsibilitiesand this will cause frustration and alienation

4.1.5.2. BRIEF EVALUATION OF THE TEAM

Q: How did your group work? Could you give me a very brief evaluation?

When they were asked about how they organized the project in the international team, some of them got to work with as a unit whereas others divided the team in two subteams by countries with one leader per subteam and country.

S2: we divided us into swedes and americans early on and set goals for each subgroup then we had semi-regular meetings so the "plan" was good, but it didn't work really that nice
 ple first there was a misunderstanding on how the documentation was to be done, the division: usa: robot stuff, swe client and server we agreed upon first we swedes make a rough doc of our parts, then we send it and they fill in their parts. (...) so we made a fairly large amount of work and they just looked at it and sent it back with something like "there will be a robot" in the robot section...

A2: I was the main leader, but I knew that I couldn’t be around when ever the Uppsala students needed me, so I has a Uppsala group leader as well. This worked very well.

F: we divided the teams by country, and there were some issues in one of the teams at one point concerning each members work amounts, which affected their motivation a bit. But otherwise the group worked very well and there were no problems whatsoever. Each team had a responsibility( server, gui, robot) and it was a good division since then the issues in each subproject could be handled inside the team locally only the interfaces between the subprojects needed to be clarified in the meetings. The time difference was a bit of a problem because it wasn't easy to solve some things between teams before the meeting. We sent some mails to get them solved and it worked ok
Other challenge that the course arise to students is the work in a team with a considerable number of members. The teams are made up for an average of 6 or seven members even a team had eight members. At university, students are used to work in teams or two or three persons but in the Industry, the projects usually are carried out by bigger teams. This fact may main a difficulty for the students. When they are asked about it, they explains the found problems:

- **Q**: What do you think were the main conflicts and problems working in group of 6 or 7 persons?

**S5**: It’s hard to meet and communicate when 7 persons live in 2 different countries and we all had different schedule. That time difference between USA and Sweden also make things harder.

**A1**: for our group, it was 8 of us we figured the easiest way to go about working with such a large group, was to have two team leaders 1 team leader was over the uppsala 4, and another was over the US 4 this way there wouldn't be multiple lines of communication, the two team leaders communicated the leaders synchronize their team, and then the leaders synchronize themselves.

**S1**: In our group we were 4 swedes and 2 finns and I think that the finns felt that they were a minority and just accepted a lot of the decisions that us swedes proposed.

### 4.1.5.3. EFFECTIVE MEETINGS

**Q**: Do you think were effective the meetings?

**Could you describe them?**

**How were the meetings managed by the group?**

Meetings were used by teams to update the progress of the project until the current moment and plan the next actions of the project. Most of team managed the meeting in 3 phases: first an exposition of ideas and reached milestone until this time, and open discussion and reaction of the componenets of the team for each topic.

Some teams were able to hand the meetings as a very usufull tool to manage the progress of the work. Other teams had difficulties to understand other members in the team and the internal communication.

**S1**: We had a meeting on monday (i think) when we decided what we needed to do for the week and set up deadlines...we divided the tasks among the subteams. Then on thursday we had an update-meeting where we tracked the progress of the tasks that we set up on monday and deciding.

**A1**: in the beginning everyone gave their ideas, and usually a consensus was made by everyone, because we all wanted the project to be sophisticated, but
we didn't want to think to far beyond our capabilities (...) once goals started to be met, the leaders handle the meeting stating was done, and was going to be done next

S3: – IRC was used mostly; we talked about progress and problems that had come up during the week (we tried to have one meeting every week). The team leader announced a time for the meeting after scheduling with the other group members (in each country).

S7:  The first thing we did was to construct a small web application where the team leader could add a meeting and suggest times for the meeting. Every member could reply with their preferred times. Meetings were then arranged at suitable times. We had about one meeting a week.

A2: We would meet weekly at a specified time using Google Talk. The meetings were generally one hour. Then our group secretary would post the meeting minutes on the Runestone wiki(...)I would have an agenda and we would try to stick to it. Then once all the agenda was covered we could talk about new topics and ask questions. It was all text chat based so a log could be kept.

4.1.5.4. THE DECISION-MAKING

Making decision inside the team is other important aspect. The aim is to find propositions acceptable that all members support. In this case, the ability for the communication is again very important. The progress and the ritm of the work is marked for the taken decisions. Also when problems [surge], decisions must be apply to solve them. The most of teams explain that they used the [consenso] as method to decide aspect of great importance that affect to the whole team and for smaller aspects that affect to only smaller part and can be implemented without the participation of the [mayoria] are carried out by subgroups inside the team.

• Q: How were made the decisions? Was it easy to carry out in the group?

S1: the implementation was up to each sub-team so the smaller decisions where carried out locally

S2: milestones: One teammember was pre-assigned to be presenter of the meeting that would lead the discussion, walk trough what progress have been made and what's left, and if there was any questions for mentor(...)most decisions was made in consenccus, all agreeing and discussing the matter until we reached agreement (...) yes it was quite easy but it think it is mainly because we swedes had discussed amongst us the project and had a fairly clear idea how we saw the problem, while the americans seemed to come to the meeting "unprepared"so it was mostly a deal where we said stuff and they agreed

S7: We all had different areas that we were responsible for. We took decisions
about our own areas. Big decisions were done in group where team leader had the last word. I didn’t experience any problems at all with this way of working.

4.1.5.5. ESTIMATION OF WORK PLANS

Learning to estimate work plans like time plans, effort plans, cost, resources, etc is usually a hard task that is really crucial at the beginning of any project and it influences in a huge measure in the rhythm and evolution of the project. In Industry the estimation of time and persons is money because usually the cost of a project is measure in number of persons per month or week. Like this is translate to money in Industry, the estimation is a really important aspect. To get the partial milestones and get to finish the project in the agreed moment is defined by the estimation.

In the Runestone course, students must elaborate plans of time and task in the first phases of the project and adjust the rhythm of the work to these plans to get objectives. But the estimation is usually difficult to realize and the students explain that experience in large project is very important to make correct estimations. Students are not used to make estimations for large projects, so it is other challenge to learn that could be very useful for their future professional career. When they are asked about how was the estimation in their team, they explain the following ideas:

- **Q: Are they trained to estimate work plans (time, resources, effort, ...)?**

  *S4:* we also knew it would change because none of us had any experience of this sort of thing so we didn’t know how to do anything really when we started

  *S1:* estimating time was hard... since the problems we needed to solve where new to us

  (...) we made a very rough timetable early on in the course, but later we just took one thing at a time, setting micro-deadlines for the smaller tasks. Also, it was not really clear what was expected at each milestone so that made it a bit tricky (...) there were some aspects of the course administration that made it a bit harder

  (...) the wiki was not consequent and up to date in all parts and the Finns only had limited access to their computer-lab... also the tools only worked in full on Windows XP which only one person in the group was using...and so on...

4.1.5.6. STRENGTH AND WEAKNESS OF TEAMWORK

To summarize the experience of the students working in their teams in this course, they are asked about over their experience in the course, what points were more positive and what were more negative or difficult.
• Strength can be categorized in:
  - different viewpoints to focus the problems
  - learn of each other in the team
  - enrich the technical knowledge
  - different focus about work in team, learning of persons of other
countries and learning to deal with them in problems.
  - collaboration and help from other members
  - all team informed in each moment about the important aspects of
the progress
  - social skills
  - working in parallel and module and coordinate the work between
the different members of the team.

• Weakness can be categorized in:
  - difficulties with the communication
  - difficulties with members of other countries (difficulties of
understanding)
  - difficulties with time differences and schedules
  - decision took a long time

Q: strength and weakness of group work

S4: one big challenge with team work is keeping everyone informed about all
that is going on

S6: the strength is the gain of knowledge and expertise of technical merits, to get
to know people, and to see how you function in a mandatory social context. (...)weakness is that the social dynamics within a group can be cumbersome and
affect your project

A1: the strengths were the number of people who were able to complete task.
You didn't have 1 person working on 5 different parts of the project (...)if a
problem occurred there was always someone available to maybe lend a helping
hand. I could always ask for suggestions from multiple people on how to
accomplish a set goal like stated before, the greatest weakness was being able to
meet when everyone was available
(...) the entire U.S. team all had other classes, as well as work so that stood as a
problem for us, once we got our schedules together, next we had to get the
availability of the Sweden team (...) there schedules were hectic, but Sweden
was 6 hours ahead of us, so when there were getting done classes, we all were
just getting up and when we were getting done with classes, they were in bed (...)it
was, but it also was a great experience

A2: but a weakness was that decisions took a long time sometimes.

F: the main strength was the communication skills, we came along very well
with each other and also had fun in the meetings. The technical skills of some
members could have been better, and we had to make some work that wasn't actually ours
even though the technical part is not the main part of the project, it should be a requirement that everyone is able to do the needed work

4.1.6. INTERNATIONAL PROJECT

The course is developed in a multi-cultural environment where 3 different countries take part. This is the big challenge for teachers and students: on the one hand for teachers, to create, organize and coordinate a course with students in different countries and on the other hand for students, to learn to work and execute a large project in a team with members with who only communicate with online methods.

The students are asked about how was their experience in this aspect, focusing the question in 3 directions: difficulties, advantages and skills found working in an international group.

Q: What do you think are the main difficulties, the main advantages and the most important skills acquired by students working in an international work group?

Difficulties, advantages and acquired skills are classified in the following categories:

- **Difficulties:**
  - Time differences
  - Cultural differences
  - Coordination and communication

- **Advantages:**
  - Time differences (you can use them to your favour)
  - Different experiences and ways of working
  - Teams with higher perspective to work and viewpoints

- **Skills:**
  - Communication skills
  - Which tools that work, which doesn’t in a large project
  - Social skills to understand and accept and use the other countries culture

**Time differences:**
The course is developed between Europe and United States, therefore different time zones is other factor to manage. Students must organize themselves with a different of 6 hours in their schedule, even between Sweden and Finland there is one hour of difference.

**Cultural differences:**
Logically cultural differences exist between students of different countries.
Students find it as a difficulty and advantage at the same time.

A2: To me this was a new experience. To work with another country's culture and work style was very different then working in a group from the same company. I learned a lot about how to manage a large group with differing views.

S6: People can continue work while the other team are sleeping and obviously meetings gets difficult most important skills are probably documentation to minimize errors and make sure everyone is on the same page. I guess social skills as well to understand and to accept and respect that there is different cultures. And try to see the benefits and not the differences.

Coordination and communication:
They are presented by students as a complicated points to manage in the international teams. The communication is based only in online methods without presentational encounter between part of the team so these tasks turn into challenge to solve with success.

S2: As a school project I would say the main advantage is that you get a feel for how it works, working with students that does not have the same schema/daytime/activities as you do.

S5: The difficulties are the time difference. The advantages are that they may look at things from another angle. The most important skill is how to work with people across the world that you never have seen in real life.

Different ways of work:
A wide range of viewpoint and experiences is present in an international team. Obviously, it enriches the performance of the team work and students may learn many things of their mates.

S1: Advantages: Having people with different abilities and experiences in the group.
Skills acquired: Managing the software development process in a project of a slightly larger scale than we are used to, communicating your work and also leadership and organisation.

A1: Advantages - having the resources of other group members to provide help when needed other group members being from a different university or country, made provide better insight on a subject because they took a class on a certain subject, or they were taught a specific but different logic than i (...) being from a different country or university could provide different and sometimes better resources.
Q: Do you think cultural differences between the three participating countries could they make harder the communication of the groups?

S4: the americans did not ask for help they also seemed to want confirmation from the teacher all the time

A2: Yes. I think this had a lot to do with motivation and how committed certain members are to the project.

S6: Yes, americans and swedes are quite different and what things it may have influence? like project evaluation. Swedes are generally more cautious americans generally braver in their assessments as in how much has been done and how good the work is

S1: but then there were some cultural differences which came apparent during meetings - some people more silently agreeing which might have caused some frustration(...) and IRC in itself is not a very effective means of communication

4.1.7. OPINION RESULTS

Q: What is your opinion about the results of the project and your experience? What is your assessment about the course results?

S1: Well we managed to solve the problems that we set up to solve and we didn't have to work our asses off at the end of the course... it was well planned. But I think it is a bit discouraging that one can only get two grades for the course... Fail or Pass

S2: I think this was one of the most diverse and "learn-full" courses i have taken at the university of the results: our robot did not fulfill all the demands that it should, but given our group composition we did very well (...) our mentor did not think we would have a working robot at all at the end of the course. But again, i was sort of the hub of the entire project in our group so i spent ALOT of hours that was "not necessary", like teaching java, programming the robot, organizing the filestructure of our svn and alot of other stuff

S3: We realized that all “extra” features we had in the beginning were over ambitious.

A1: > we met the goals of the course, but there were more goals that we set, just for ourselves that were not met, due to the few weeks we fell behind looking from the professors side, the results of the project were great. From our side, were content that our results satisfied the grading party, we knew we should have met all our goals

(...) the results from the course reflected our effort, effort was minimal in the start because the project was so broad, and many questions needed to be
answered, before we could even think about programming but in the end, we put in %110 everyday to make up for the lack of effort in the beginning, and the weeks we missed out on <cocoalfred> and the course results reflected this all

A2: I think that this coarse was very fun and taught me a lot about myself. It helped to prove that I could bring all the things I learned together and make a useful project.

F: I think it was a very successful project in all. Learned a lot on SW project, and the things that a professional SW project needs, had to be thought there. It wasn't as accurate as a professional project but the main idea was the same well... the requirements technical skills should be more clear i think. But otherwise I can't hink of any now
Chapter 5

Conclusions
In their incorporation to Industry, students of Computer Science face up to demands of professionals where in technical aspects are perfectly trained by University and not technical aspects demanded that sometimes are not so presented during their university education.

Runestone project has the purpose to offer to students a course that frames a technical project in a framework where are developed other complementary abilities so that the final result has fulfilled with successful. Students must be aware of the importance of the development of these abilities in professionals of computing.

After the study of this thesis, the stance of the teachers is defined for the followed aspects: the current teaching in higher education in Computer Science needs to be closer to the professional practice, with courses where the student can develop also not technical skills that involve the technical projects in Industry. With Runestone course, teachers try to develop in students skills of management, capability of decision and approach, ability of definition of requirements of projects that usually are few defined in Industry, search of tools and technical support, organization and planification of tasks, ability of interpersonal communication, understanding of different cultures and work in team. All of that involves in an international frame.

The stance of the students is defined for a general feeling of lack of not technical abilities during the degree, thinking in their close future incorporation to job market. After Runestone course, all of them agree that the course gave them important learning of these abilities like management, work in an international team and a wider perspective of the set of tasks of a project. Also, the course gave them the opportunity to analyze themselves individually and assess what aspects must develop with a view to the future professional practice. For students, the work in team in an environment similar to the real context in a company that the course offers, is the aspect more deeply studied because it is the key for the successful of a final project in computing.

In a job market so competitive, the University must support to the students in these disciplines for having as result prepared students for the current demands of Industry, competent, motivate and active professionals in Europe and support them to face up their incorporation to professional practice with successful and projection of future.