

COLLABORATIVE LEARNING IN INTERDISCIPLINARY AND INTERCULTURAL TEAMS

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Abstract—*Many observers consider that Engineering courses in general should turn out graduates who*

- *Are proficient with open-ended problem solving*
- *Are familiar with multidisciplinary problems*
- *Posses teamwork skills*
- *Posses appropriate entrepreneurial and social skills*
- *Are able to plan and run a project effectively*
- *Have the ability to communicate efficiently*
- *Are proficient with computer systems and applications*

Let us admit that the Paradigm has changed and adjust accordingly. Various avenues of teaching, learning and assessment, such as those described in this paper, are required to develop soft and hard skills needed. The educational concept described i.e. simultaneous cross-cultural and interdisciplinary teamwork influences the individual personal attributes. Through project organized teaching/learning mental agility as well as inner resilience are influenced and strengthened. After completing this semester course students posses a blend of personal attributes and soft and practical entrepreneurial skills. Further it has been shown that students learn good judgement tinged with sagacity. In using our modern computer facilities students become rather proficient in management of engineering projects and applications.

Index Terms—*Avenues of learning, diversity, international teamwork, project performance, theory and practice*

INTRODUCTION

Global awareness is of paramount importance. International collaboration and cooperation are developing very fast and require knowledge and understanding of cross-cultural business behaviour. In order to deal and compete on the global market, we must make sure that the qualifications of our engineering graduates are appropriate. Future researchers predict, that work in future life will merge with leisure time and family life making things more blurred. It is expected that engineers in the future will be given a special task rather than being employed in a company from nine to five. In Denmark there is already a tendency to employ people on short-term contracts buying competence and expertise rather than employing people, as we know it to day. This requires a solid basic engineering knowledge combined with the ability to tackle problems alone and solve them in cooperation and collaboration with people across disciplines and cultures. Understanding of a broader area of disciplines such as

economics, marketing, environmental subjects, management of engineering projects and a solid training in teamwork are required. Both Society in general and engineering have become increasingly more technologically advanced. This produces a demand for many new skills that our graduates must posses. The new skills base is no longer just technological. There is now an increasing demand for our graduates to be proficient with open-ended problem solving and with computer systems and applications. In addition, to have the ability to plan, navigate and manage complex engineering projects, work systematically and be able to work in multidisciplinary teams with international participation where the common language is English.

A major supporting activity in engineering courses in Denmark is the use of an extended project based activity. This is to day considered to be such an important part of the general teaching technique of learning that it is being extensively employed. This teaching and learning technique is based on the dual concepts often referred to as Collaborative learning and Scaffold Knowledge Integration.

COURSE DELIVERY

As described in the Scaffold Knowledge Integration framework, autonomous learning is facilitated on the course by having students work in project groups to allow them to:

1. Serve as social supports for each other
2. Share design ideas and provide feedback
3. Provide critical assessment of the ideas of others
4. Discuss, negotiate, debate and compare

The assignments undertaken are designed to make students listen actively to each other, to make mistakes, to argue, to discuss and to explain their ideas to other students, to members of the academic staff and to experts from industry.

FINDINGS

Interdisciplinary working combined with the participant's diversity in cultures needs careful scrutiny by lecturers, supervisors, mentors and participants. A number of key issues are the differences between the deal focused and the relation focused way of conducting meeting and negotiating between different suggestions. The level of informality in some cultures such as Denmark and the UK and the formality-structured relationships in several mainland Europe cultures can cause strained relationships. Sensitivity to status differences and the

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rigid hierarchies frequently displayed in a number of Universities can also provide initial uncertainty in students.

DIVERSITY

To appreciate diversity and take advantage of it in collaborative learning is essential. However, to do so we need to be aware that each individual has a perception and understanding of the way things are or should be. This situation is strongly accentuated when dealing with students mixed in multi-cultural and multidisciplinary teams. All involved i.e. students, supervisors or staff should know that diversity in cultures means different mind-sets and therefore many individual paradigms. Normally we do not question such differences in our individual perception of life. However, this is exactly what we need to do when dealing with mixed teams of different disciplines and cultural backgrounds. Each team is typically a mix of three different cultures and four to six different disciplines working as an integrated engineering group. All projects are real projects done in cooperation with Danish or foreign industry. Language of communication is of course English.

STUDY DISCIPLINES INVOLVED

The basic structures of the programme of study are designed to give participants an overview of the diverse fields of engineering business and technology and to break down barriers between disciplines and promote a common approach. This course has shown to familiarise the students with the practice of engineering analysis, design and problem solving. This is achieved by providing a set of project-based activities designed to simulate the real world engineering practice. In this case practice relates to the skills required to achieve a successful project. At the start of the project student teams struggle with their project/problem formulation and planning trying to allocate activities related to the individual fields of study involved. As the project progresses the differences between each of the technical disciplines begins to disappear, and the class begins to extract engineering and technical skills that are consistent across disciplines involved. This is where student starts to recognise the interdisciplinary nature of the operation and see the possible solutions to the various parts of their project.

PROJECT PERFORMANCE, LIMITATIONS AND DIFFICULTIES

It is well known that it is necessary to have a certain amount of knowledge and insight to be able to resolve problems and to be creative. To accommodate a wide range of student disciplines requires a great number of broadly based projects within engineering, business and technology. To accommodate different cultures and disciplines in the same team requires certain skills, patience, time and understanding. It further requires consideration and courage to resolve cognitive, political and social problems as they occur. Although students

technical background/knowledge is similar it can be very difficult to communicate. Also conflicts in student's individual aims and ambitions must be published and discussed among team members to promote the project performance. Further it is important to tell each other what is required of the home university. In case of trouble a facilitator, usually a supervisor or a qualified tutor is consulted.

AVENUES OF LEARNING

Following is a list of avenues of teaching and learning applied:

- Project Organized Teaching i.e. problem oriented or discipline oriented.
- Self study
- Independent and autonomous learning
- Traditional class teaching
- Working together where students share and distribute the responsibility of learning
- Helping each other
- Collaborative learning
- Supervisor consultation
- Practice of making things (prototyping)
- IT, Blackboard, web learn
- Ad hoc teaching according to immediate need
- Group meetings
- Tutorial sessions with Oral Presentation exercises and written feedback from the audience

METHODS AND TECHNIQUES USED

A mix of different situations and events deliberately designed reflects the avenues of learning practised on this semester. These events enable students to present, discuss and defend their professional work and discuss other matters of concern such as communication problems, cognitive and political problems in their group. Teaching and learning methods such as autonomous learning, tutorial discussion sessions where oral presentations are performed and discussed, group meetings where teams present, defend and discuss their work with each other, weekly meeting with supervisor, here students plan, organise and prepare the meeting, they work out the agenda for the meeting, they take minutes and they take turns in chairing the meeting. As we express it: We pay attention to the 3P's as we have defined it: The PRODUCT i.e. the documentation set, the PROCESS performed i.e. the teamwork and the PEOPLE involved. Also use of our web-based blackboard system should be mentioned which is used as a distant learning tool. It is also used as a forum for discussion. Here the professor can work on distance and participate in discussion with students. Each team of international students is involved in defining, systematizing, planning and navigation of their project. Two supervisors, a commercial and a technical, are allocated to each team. On compulsory weekly meetings things of concern such as project development, teamwork problems and

communication difficulties and if needed cognitive and political problems are discussed. From those meetings students learn good meeting techniques and disciplined behaviour. Further they learn to work out a good agenda for the meeting and to write a good minute of the meeting. Abilities such as awareness, self-confidence, responsibility and communication in English are improved through those activities. Also the ability to listen actively, discuss and negotiate solutions in place is developed. Company advisors do join the weekly meetings if their busy timetable allows. All team supervisors meet regularly to discuss matters of concern.

THEORY AND PRACTICE

It is essential that University reach out to Industry to establish a good relationship. It is crucial to get industry involved and committed in education of engineers. The Engineering College of Copenhagen is an undergraduate institution. The study is vocational i.e. a mix of theory and internship in industry. Students enrolled here find this combination very useful and relevant and a real eye-opener to many students. To illustrate their concern for a proper mix of theory and practice the following statement, expressed by a student representative at a graduation ceremony, will serve. Quote: "Theory is when you know everything but nothing works. Practice is when everything works but nobody knows why. Therefore keep calm and combine your knowledge or else you might find out that: Nothing works and nobody knows why" Unquote.

ASSESSMENT

Interim report, self and peer assessment, project report and oral exam. Assessment procedure for the team-based project:

1. Oral presentation of the written report
2. Discussion of professional, technical and specific content of the report
3. Discussion of the precise communication value of the written report
4. Evaluation of the project-process

MOBILITY OF STUDENTS ACROSS BOARDERS

Since the inception of the European Union student funding programmes such as Socrates/Erasmus, Leonardo, Tempus and Comett students have been increasingly encouraged to move part of their study to a foreign University. The number of students and the range of countries annually involved in international exchange of students have increased dramatically. The EUROPEAN PROJECT SEMESTER (EPS) programme reflects this general trend. From six students in 1995 coming from three countries to 80 international students per year coming from 14 different countries in 2002.

STUDENT STATEMENT

Andrew Perez, a participant in 2001, graduate from University of Notre Dame 1999 with a degree in Mechanical Engineering says about this international teamwork semester: "This semester programme is essentially a semester devoted to a final design project, which is provided and partially supervised by Danish companies. Just like at Notre Dame it entails a team based approach, a lengthy final paper and also a final project presentation. The difference, however, is that my team-mates were from different countries. My team consisted of three women from Spain, The Netherlands and Lithuania. Likewise, the six other groups comprised of multinational teams presenting most of the countries in Europe. Within my group there were two engineers and two business majors, which was tailored perfectly to our project.

Let me start by saying that I cherish this experience as much as I do my four years at Notre Dame. I have learned more about world, the life and myself in the last five months than I have in my previous 24 years of living. I came to the programme believing that with my credentials and experience, I would be able to easily succeed in this setting; I have never been so wrong in my life. My error was that while I have experience working with Americans of various ages and egos, we are all American and therefore predominantly of the same mindset. When I started working within a multi-national team, I found myself having to reinvent my work habits, my communication skills and my choice of words. It was a huge and complete paradigm shift.

Personally, I am forever changed because of this program. I can assure you that this sentiment was also shared by the other American attending and by every single other participant. I am not sure how this program would fit into Notre Dame's strict four-year curriculum, but if you are serious about improving the quality of the degree, then look no further than across the Atlantic to a small country in the north".

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