CDIO, NETWORKING AND COLLABORATION IN A CROSS-BORDER CONTEXT

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ABSTRACT

This article describes experiences gained during efforts to develop engineering education to support students' personal and networking skills, which are considered an essential element of (CDIO) skills. The data was collected during a cross-border study project organized in two higher education institutions (HEIs) operating in northern Sweden (Luleå) and Finland (Kemi) in the autumn of 2013. A total of 21 student participants from the two countries were divided into four multicultural teams. During this project, students were expected to develop interpersonal skills such as teamwork, communication, and communication in foreign languages. Additionally, personal skills and attitudes were required, such as creativity and critical thinking, awareness of personal knowledge, and time and resource management.

Today's turbulent and multicultural working environment presents a huge challenge for every engineer. This challenge must also be considered in engineering education, which has to be renewed continuously. It has to look for new approaches to offer experimental learning situations and environments. Students need to be able to develop their personal CDIO skills and attitudes in different learning situations. In this process, the university's role is to enable different learning experiments and support teachers to utilize their knowledge, skills, and personal networks. Specifically, the article covers the survey data collected from student teams. The purpose is to analyze their networking experiences and awareness of developed CDIO skills in a cross-border context. Moreover, relevant scientific literature is analyzed to form an adequate theoretical basis. The study is part of the northern Scandinavian Innopreneurship 21 project, which aims to create a center for entrepreneurial learning competence in each partner HEI. The purpose is to enhance development of entrepreneurial behavior and entrepreneurship by utilizing a virtual learning environment which will be available for all HEIs that are willing to join the network later.

KEYWORDS

Engineering, networking, collaboration, communication, cross-border. Standards: 3, 7, 8, 11.

INTRODUCTION

Engineering education aims to train students to operate in changing and turbulent working environments. Engineering graduates need to be innovative, active, proactive, and collaborative [1, 2]. They are also expected to have an entrepreneurial mindset and behavior. The main challenge for universities is to offer learning situations that enable students to develop competencies and skills needed in their future working lives [1].

Engineering graduates utilize their entrepreneurship competencies either as employed or self-employed individuals or in establishing new ventures [3]. Entrepreneurship and operating in business environments also require self-efficacy and tolerance for ambiguity [4]. The educational system traditionally focuses on strengthening the professional knowledge base needed in the working life. However, developing other competencies such as (CDIO) skills (e.g., creativity, communication, and collaboration) and an entrepreneurial mindset can be more challenging and requires evaluation of the whole learning process throughout the years of study. In practice, this means that the learning environment has to be open and versatile. Therefore, teachers need to be prepared to test different learning situations themselves and take risks.

Networking and collaboration skills are highly valued in the working life. In earlier research, it has been studied that employees need social capital, which can be developed as a result of networking in different contexts. Personal connections, either based on systematic (strong ties) or random ones (weak ties), create the basis for social capital. The growth and development of organizations, even regions, seem to depend on the social capital of individual employees as well [4]. This finding confirms that universities have to open opportunities for creating contacts during the years of study and the whole learning process.

Additionally, it has been argued that the existence of personal networks is the prerequisite for entrepreneurship [5]. Recent studies contend that to be successful today, the entrepreneur should be agile and aware of situational elements, and utilize the available means and personal connections in different situations.

The working life is multicultural today. Thus, learning situations that include collaboration with students from different countries and cultures are valuable. Students are enabled to develop their intercultural communication skills, which are considered an important competency of engineering graduates [1]. Studies in a cross-border context can be defined as a form of internationalization of education [7, 8]. Different organizations and stakeholders demand that higher educational institutions operate actively to internationalize education.

This paper aims first, to study the experiences engineering students gained about networking and collaboration during a cross-border course. A second objective is to find out how participants' CDIO skills evolved in that context. A third purpose is to outline suggestions for developing engineering education to support the development of graduates' interpersonal skills.

THEORETICAL BACKGROUND

Engineering education has focused on building engineering practice and engineering-science base traditionally [1]. Due to the changes in working life and globalization, educators have had to re-evaluate the methods of teaching and learning. On the other hand, students today have different skills and abilities; they represent the Internet generation. Therefore, they are familiar with utilizing certain equipment and tools, but at the same time, their knowledge about the possibilities and requirements of engineering studies and the profession is inadequate. In response to these developments, it has become necessary to renew engineering education to develop the competencies employers demand.

According to the CDIO initiative, the engineering syllabus should enhance the development of

CDIO skills, which entail personal skills and attitudes, interpersonal skills, and product and system building skills [1]. In this paper, the most relevant of these attributes are personal skills and attitudes, which include risk taking, creativity, flexibility, and critical thinking, and interpersonal skills such as teamwork and communication. Regarding competencies of engineering students, the working life emphasizes the need to practice working in multidisciplinary teams [9]. That way, students can learn and experience the benefits of teamwork and cooperation when creating new solutions and ideas.

In addition to the CDIO skills, engineering graduates are expected to demonstrate an entrepreneurial mindset and behavior, on which both employers and public organizations agree [3]. Entrepreneurship is globally considered an important source of economic development and prosperity. Some researchers even claim that entrepreneurship should be regarded as one of the core competencies or generic skills an employee should possess [10, 11]. Entrepreneurial behavior can mean seeking opportunities, taking initiative, and solving problems creatively [12]. As expressed in the Lisbon strategy, "Combining entrepreneurial mindsets and competence with excellence in scientific and technical studies should enable students and researchers to better commercialize their ideas and new technologies developed" [3]. Moreover, it is a general trend that engineers operate and cooperate in interdisciplinary arenas; therefore, the significance of communication and social skills is even more emphasized [13].

Networking has been defined as a proactive action that helps individuals create and maintain relationships needed in future career building and operating in different roles in life [14, 15]. Typically, building a network does not have to comprise a group or an organization or be tied to one role. Additionally, an entrepreneurial perspective is needed in networking, because the focus is the 'opening' of opportunities to be utilized in the future [14]. As argued in earlier research [5], successful entrepreneurs are both able to create and utilize their personal networks in entrepreneurship. Thus, if our aim is to train engineers with networking skills and entrepreneurial behavior, the learning environment needs to allow that. Personal networks are also found relevant for building up social capital, which seems to play an important role in developing individual organizations and even regions [4]. This conclusion was drawn from a research that studied the success factors of small technology parks in northern Finland and Sweden.

Cross-border education is usually understood as a form of internationalization abroad, involving the idea of transnational activities [8]. Cross-border education can mean that a) a person studies abroad, b) an educational program is arranged abroad, or c) an institution arranges education abroad [7]. In this paper, cross-border education refers to actions between the neighboring countries of Finland and Sweden. The results are introduced in the following section.

CROSS-BORDER COURSE

Practical organization

There were 8 students from Sweden's Luleå University of Technology and 13 students from Finland's Kemi Tornio University of Applied Sciences. All the Finnish participants were fourth-year, bachelor in engineering students. The Swedish students' major fields varied from social sciences to business administration, and they were mainly in their fifth year at the master's level. In both countries, there were both female and male students, divided into four mixed

international teams. Four teachers supervised the project, two from Luleå and two from Kemi. The project language was English.

The students' main task was to examine how Finnish and Swedish companies conduct cross-border collaboration. The students themselves defined and contacted the companies that they researched and studied. There were companies from different business sectors: industrial, mining, small businesses, large businesses, and logistics. Each group selected 2 business sectors; altogether, their study sample comprised 10 companies in Finland and 10 in Sweden. Moreover, the students visited 4 companies.

There were several learning objectives for the study project. The first was to familiarize the students with international business operations. The second one was to acquaint the students with collaboration on a general level. The third objective was to understand and examine how companies perform cross-border collaboration. Finally, the project intended for the students to practice international team and project work.

The study project started on November 4, 2013 with a common seminar day in Kemi. During that day students were informed about collaboration and networking, and Hofstede's cultural dimensions. For familiarizing the students made a "fast portrait" of each other. In addition they were trained for teamwork through three exercises (team introduction, teamwork commitment, team effectiveness). Altogether, they spent five and a half weeks of working time. Halfway during the period, a milestone review meeting was held with student teams and teachers for finding out challenges teams had faced. Thereafter each team were coached for solving possible challenges. The final seminar day was held on December 11 in Luleå, where the students submitted their reports and gave the final presentation. The students did not meet face to face in between the seminar days. The Moodle learning management system was used as the course platform. The students also used social media and web environments such as Facebook and Google Drive. The learning environment consisted of traditional classroom work, e-learning management system, and social media tools. Moreover, the students visited several companies and carried out field interviews there.

Research method

The major research interest was on students' teamwork and communication skills in a cross-border context. The research focused especially on the CDIO Syllabus v2.0, chapter 3, Interpersonal skills: teamwork, communication, and communication in foreign languages. The 17 questions on these topics comprised both open and multiple-choice types, with the latter consisting of poor, fair, ok, good, and excellent options.

The research data was collected from all the students (n=21) who participated in the course. All the students filled in the questionnaire individually on the final seminar day after all the presentations. A group feedback session with all the teams was also carried out. However, this research was based on the students' individual feedback questionnaires.

Results

This section presents the students' experiences and feedback on the cross-border project course.

The team formation and get-together phase achieved a significant level of success, with most

students giving a “good” rating. All the Swedes estimated that they succeeded “ok,” “good,” or “excellent.” Among the Finnish students, the dispersion rate was larger. In the definition of team roles and responsibilities, the dispersion was a bit wider. Nonetheless, the average score was at the “good” level. Similar results were found in succeeding in the team goal and working agenda definition. The dispersion was wide, but the average of the answers was “good”. Figure 1 represents these answers.

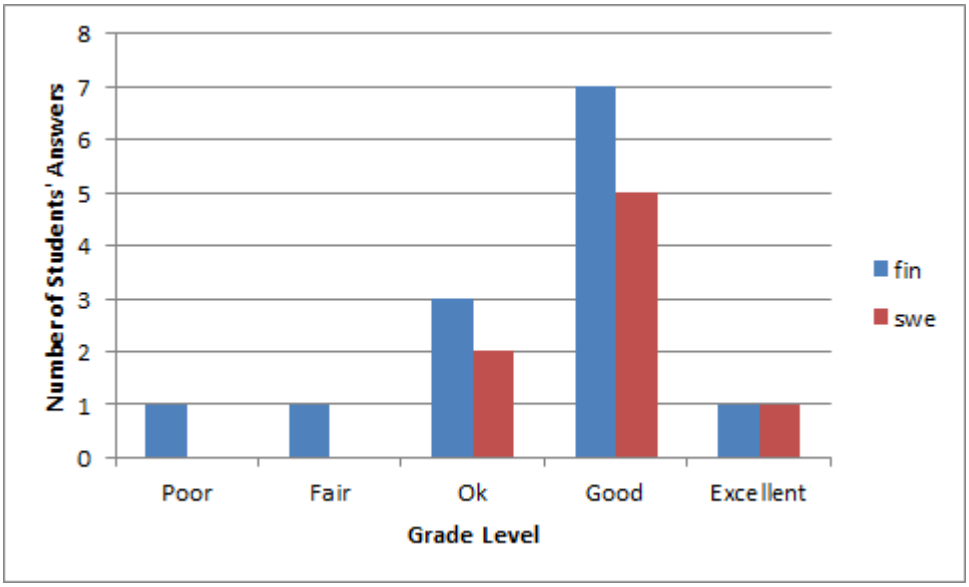

Figure 1. Definition of the team goal and working agenda.

The major challenges in teamwork related to working styles, decision making, and some technical issues. The most positive experiences were getting to know new people, gaining new international experiences, and generally learning from one another.

Here are some students’ feedback:

“Different understanding on what we are actually doing and how to do it.”
“Learning new ideas for collaboration. Making new friends.”
“It was really a fun project in general, a lot of fun, and I believe all of us learned a lot about collaboration and each other.”

Team communication also served an important role during the project because of cross-border circumstances. The majority of the students considered that they succeeded “ok” or “good” in team communication. With the project duration of only five and a half weeks, the teams made decisions and worked hard over such a short time period. On average, they answered that negotiation and decision making was “ok” or “good,” but some students considered that they succeeded at the “fair” or “excellent” level. These answers are shown in Figure 2.

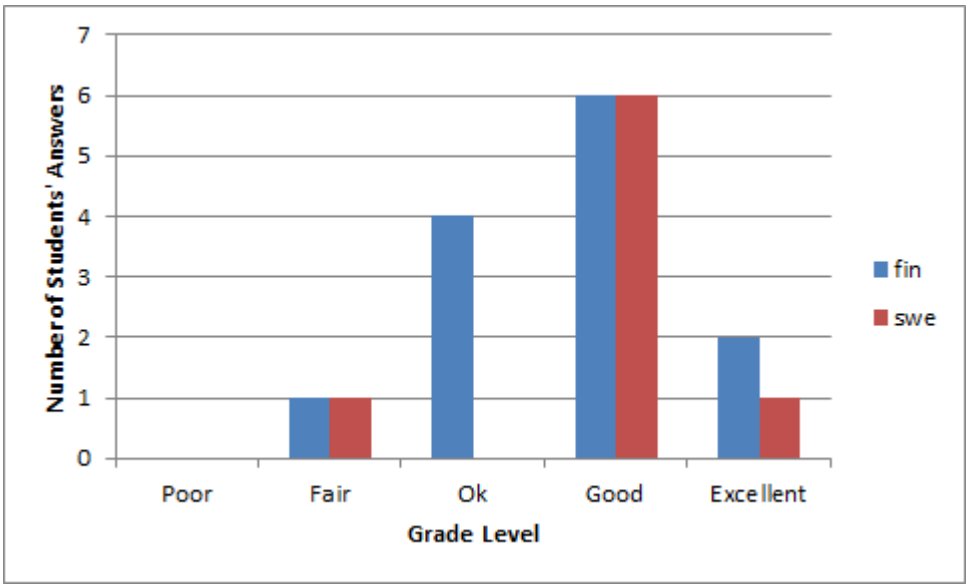

Figure 2. Team negotiation and decision making.

The teams met only twice during the project. Most of the communication was done via the Moodle environment, social media, and other web environments. The teachers guided only the Moodle learning management system, including the chat option. The other ways of communication were based on the students' own decisions. On average, they considered that they succeeded "good" in electronic communication (Figure 3).

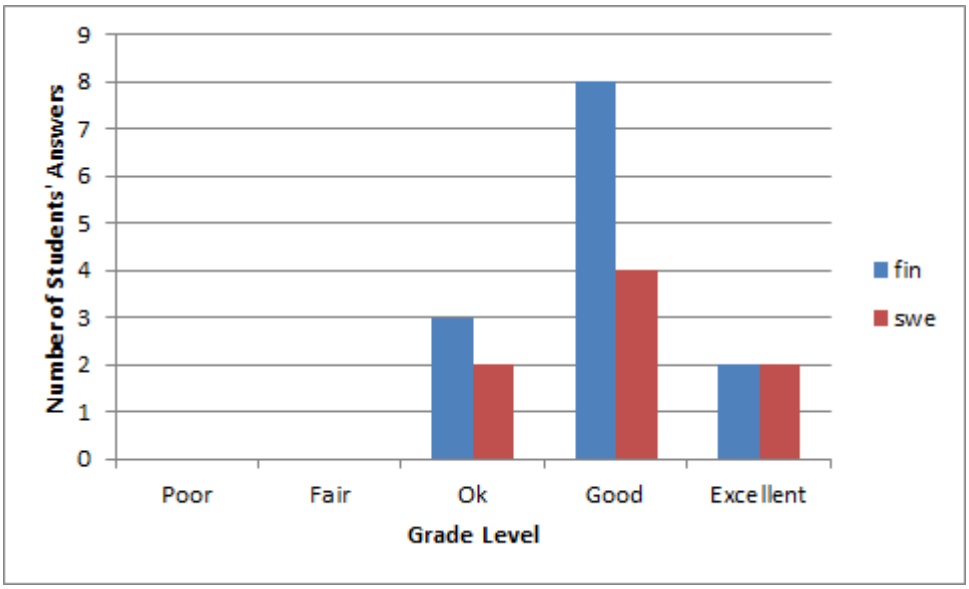

Figure 3. Success in using electronic communication.

All the students were native Finnish or Swedish speakers. In Finland, people study Swedish in elementary school, high school, and university levels. Anyway, the course was delivered in English, a foreign language for all the students. In their opinion, on average, they succeeded well in communication in a foreign language (Figure 4).

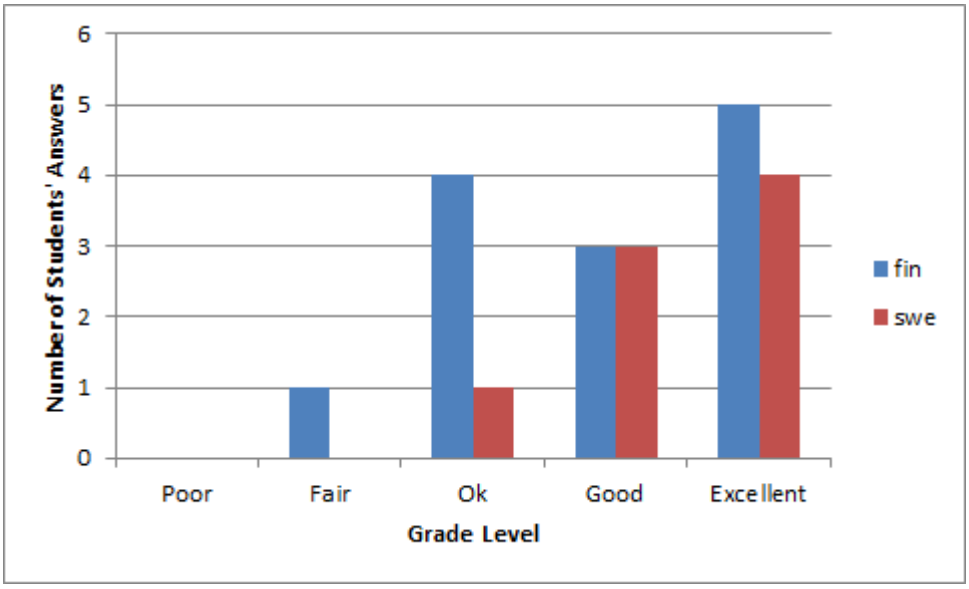

Figure 4. Personal success in communication in English.

The students encountered diverse challenges in team communication. Naturally, the lack of face-to-face meetings was considered a challenge. The students also found it sometimes difficult to set up common times for web meetings. Some misunderstandings also occurred because of language problems. Nonetheless, the most positive experiences in team communication were generally related to managing the challenging task they were given. The teams found their own ways to communicate and manage the project.

Here are some students' feedback regarding the challenges:
"The lack of face-to-face contact."
"Not being able to meet in person makes it harder and can create misunderstandings."

All the teams achieved their project goals very well, which they defined as a team (Figure 5). The overall team performance in the project was also considered "good" on average, although there were answers from "ok" to "excellent."

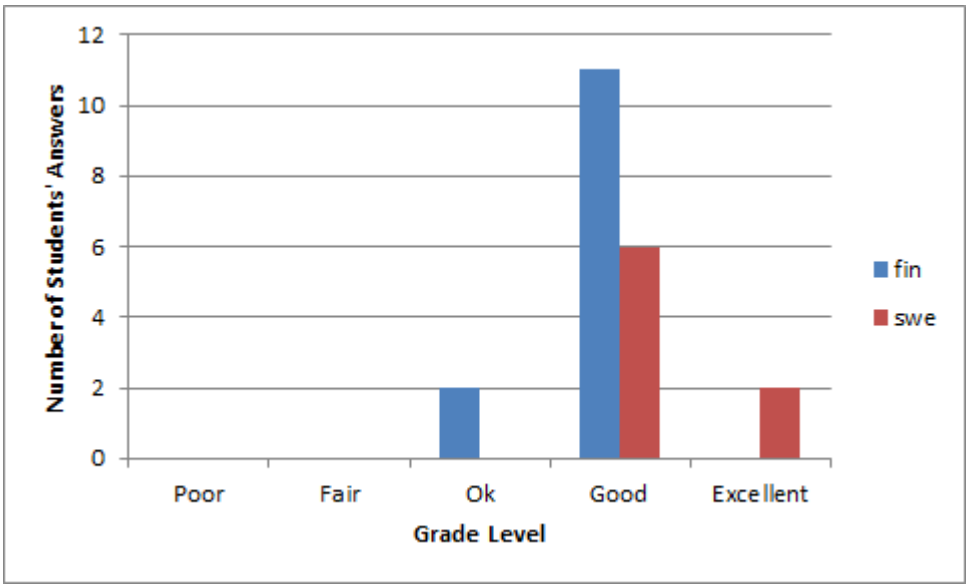

Figure 5. Achievement of the goals defined as a team.

Some of the students also faced some cultural challenges during the teamwork, related to decision-making and working methods. On the other hand, half of the students did not point out cultural challenges at all.

The Finnish and Swedish students had different study fields. All the Swedish students were aiming at master's degrees, while their Finnish counterparts were pursuing bachelor's degrees in engineering. This distinction makes the students' backgrounds and probably their expectations a little different. Related to these issues, they were also asked if they faced any challenges in working methods based on their educational differences. They found some differences, for example, in writing a report and using theory.

Finally, the students' feedback and experiences were positive overall, as shown in some of their comments:

"Very interesting course, glad to be part of such a fun project."
"The time we had for the project was a bit short. But a lot of fun."
"Interesting and different, some things that [were] frustrating, but overall, a good experience."

CONCLUSIONS

The cross-border course was a positive experience for all the participants. However, some challenges were noted. The Swedish students were unfamiliar with team and project-based learning, whereas the Finnish students have had CDIO study projects yearly. Some Finnish students considered they did not succeed in the definition of team roles and responsibilities. Additionally, some students reported that they had a different understanding from their team of what they were actually doing and how to do it. Probably they understood the challenges they would face later on due to their previous knowledge about team and project work. Face-to-face meetings were found useful and even desired afterwards. The students found it challenging to negotiate and make decisions without face-to-face communication, but results

were accomplished nonetheless. This issue did not endanger the process, but it hampered social communication.

On the basis of the results, the students considered the cross-border course an interesting experience and were able to communicate with representatives of another culture. The cultural dimension existed as well between the countries as different disciplines. The experiment was challenging due to two factors: first, the students worked among themselves, and second, they were working with companies. Despite the short training they seemed to succeed well, both in teamwork and in communication among themselves and with company representatives. Probably some tacit knowledge about team based learning was transferred between students.

The course allowed the students to create networks with their peers and with companies. It can be concluded that the course developed their personal and networking skills, which are considered an essential element of CDIO skills. As a whole, it can be concluded that the course succeeded well; therefore, similar courses need to be arranged later. Finally, the course supports collaboration between teachers and organizations, which creates leeway for future common endeavors.

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BIOGRAPHICAL INFORMATION

Dr. Soili Mäkimurto-Koivumaa has over 20 years’ experience in engineering education and is currently Principal lecturer at Lapland University of Applied Sciences (former Kemi-Tornio University of Applied Sciences) in the School of Industry and Natural Resources. She has taken her Master’s degree in Economics at the University of Oulu in 1985 and her PhD in Entrepreneurship at the same university in 2012. Her main research interest is in entrepreneurship education and action-based learning methods.

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