

SUSTAINABLE INTERNATIONAL EXPERIENCE: A COLLABORATIVE TEACHING PROJECT

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ABSTRACT

Within engineering education, there is an increasing need for providing our students with international experiences. This is most often done by exchange studies abroad. However, a majority of the students on engineering programs do not engage in any international exchange. This paper presents insights from a collaborative cross-disciplinary international project to give students international experience without having to travel. From both a sustainability perspective and a situation where e.g. a global virus outbreak stop students from travelling, solutions that give engineering students experience of working in an international setting are becoming increasingly important. Initial challenges, for the teachers involved in the project, that were addressed before the project started, included the assessment of students, the use of online collaborative tools, assessment of students and the dependence between the two courses. The learnings from the first and second iteration of the collaborative project were mainly focused around transparency, introduction of students to each other, communication, real-time issues and deadlines. By gradually remove these peripheral challenges for the students, resulting in making the students focus on the actual challenges surrounding the actual collaborative project. Even though this project is ongoing, the initial results clearly show that by integrating courses between different countries and disciplines, it is possible to create an environment that strengthens the students' ability in teamwork, communication and addresses the cultural and professional aspects of working as an engineer in an international context.

KEYWORDS

Internationalization, interdisciplinary, collaboration, Standards 1, 3, 7, 8

INTRODUCTION AND FRAMEWORK

The CDIO model (Crawley, Malmqvist, Östlund & Brodeur, 2007) with its standards and syllabus is an important tool when designing both study programs and courses within engineering. One thing that is addressed frequently within the philosophy of CDIO is collaboration, this is most notably addressed in the third section on the CDIO Syllabus 2.0 – Interpersonal skills: Teamwork and communication (Crawley, Malmqvist, Lucas & Brodeur, 2011). This is, of course, an important part of engineering education with most of the future professions of our students being focused on some kind of collaboration. However, most of the training is focused on the students working in teams with their classmates and communicating with teachers or with external collaborators within the industry (cf. Mejtøft, 2015; Mejtøft & Vesterberg, 2017). This is a great way to increase intrinsic motivation and also generate many of those generic skills that are sought after among our engineers.

From another perspective, internationalization is increasing in importance within engineering education around the globe (Guillotín, 2018). It is important not only for the students but also for Universities to increase the internationalization in our engineering programs. Universities that focus on collaboration (Srikanthan & Dalrymple, 2002) and internationalization, solving real-life problems (Damnjanovic & Novcic, 2011) are positively influencing perceived quality from a student perspective. This could influence not just future enrollment of students but also perceptions of a university's quality among other stakeholders, such as the industry and also helps universities to acquire a better position in the current international educational landscape.

Even though many of the engineering students at Swedish universities spend a semester abroad during their education, the majority of students do not. Hence, even though a large portion of our students acquire this important international perspective on their education, this is something that should be better integrated into the education programs to provide international experience for all, or most, of our future engineers. There are many motivations to why it is, and will become even more, important to give the students international experience without having to travel abroad. One being from an environmental sustainability perspective - the students' willingness to travel might decrease in the future. Therefore, students must be given the possibility to gain international experience without having to engage in international exchange studies. The situation with the Covid-19 global pandemic during spring 2020 makes this issue even more compelling when the global lockdown for several months is rendering it impossible for students to engage in exchange studies. Hence, it has become even more important to be able to create local (or even off-campus) training that includes international experiences during a student's time at the university.

This paper presents learnings and insights from an ongoing collaborative project to investigate the possibility of giving students high qualitative collaborative cross-disciplinary international experience without having to travel abroad. The collaborative project was set up between students and teachers that combined an engineering course at Umeå University, Sweden, and a marketing course at Edith Cowan University, Perth, Australia. This collaborative project has been running from 2017 and has, so far, been through two iterations, one in 2017 and another in 2019. This paper primarily addresses the parts of the CDIO Syllabus 2.0 (Crawley, Malmqvist, Lucas & Brodeur, 2011) that regards *Teamwork* (3.1), *Communication* (3.2), *Communication in Foreign language* (3.3) and *External, societal and environmental context* (4.1). The results are based on student evaluations, discussions with students and discussions among the teachers involved.

SETUP OF COLLABORATION

The goal of this project was to improve students' skills in both an international, inter-disciplinary and a professional context. The set up was, therefore, based on the students participating in an international online collaboration through digital platforms to provide students with a globally relevant and transformative social learning experience (Cela, Sicilia, & Sánchez, 2015). The locations of the universities within the collaboration was mainly chosen for two reasons – different time zones and the remote location of Umeå in the north of Sweden and Perth in Western Australia. For both of these locations, online collaborative technology is important to keep up with contacts at other locations both nationally and internationally. Furthermore, the established contact between the teachers at these two universities made it suitable for running tests.

The negative effect of working at more remote locations has during the last 15-20 years become less significant. This is mostly due to the introduction of online collaborative tools and social media platforms based on the ideas of web 2.0 (Boyd & Ellison, 2007; O'Reilly & Battelle, 2009). These types of tools and social media are today widely used by professionals to interact with colleagues, crowdsource ideas and engage with current and potential customers and users (Cripps, Singh, Mejtoft & Salo, in-press; de-Marcos et al., 2016). Nevertheless, not only the tools have become more intuitive and powerful, the users have become more used to online communication. Almost all students that were part of this collaborative project are digital natives (Prensky, 2001) and are used to working with general tools for online communication.

During both iterations of the collaborative project that has been carried out so far, the collaboration has been between engineering students on the five-year integrated Master of Science in engineering program in interaction technology and design at Umeå University in Sweden and marketing students at Edith Cowan University in Perth, Australia. During the first iteration in 2017, the fourth-year engineering course *Prototyping for Mobile Applications* and the third-year undergraduate marketing course *Current Issues in Marketing* were the basis for the collaboration. During the second iteration in 2019, the fourth-year engineering course *Technology for Social Media* was the counterpart to the postgraduate version of *Current Issues in Marketing* course at ECU. The reason for being able to use another engineering course was that it made it possible to collaborate during another semester and the two engineering courses are very similar in structure. The idea was that the engineering students created some kind of application or system and the marketing students provided the engineering students with a background investigation regarding the business potential for applications within the area when they started their work and, later on, created campaigns and marketing material for these.

INITIAL CHALLENGES ADDRESSED

Before the first iteration of the project was set up, several potential challenges were discussed among the teachers on the two courses. The major challenge that needed to be addressed involved the main problem for the teachers – the assessment and examination of the students. This is one of the most important issues to secure the grades to individual students and the continuation of the education for those studying on the respective programs. The main challenge in the design of the collaborative curriculum was because the teachers wanted all students to be able to finish and get a grade from their course even in case of collaborative problems arising. Hence, there could not be a total dependence between the different assessments on the two courses. The solution that was decided on beforehand was to use ad hoc flexibility throughout the collaboration. It was furthermore decided not to give the students

all information about the project at the start of the courses but to rather give them the information on a need-to-know basis to gradually create a better understanding of the students' situation and made them aware of the fact that they were not depended on each other.

The second challenge that needed to be addressed before initiating the collaboration was regarding the use of online collaborative tools. The universities involved used different digital educational platforms - Edith Cowan University using Blackboard and Umeå University using Moodle and Sakai. Unfortunately, the bureaucratic systems around access to digital resources did not allow for students from another university to easily be added to the other university's educational platform. Instead of getting stuck in this situation, it was decided to flip this challenge into an advantage. Consequently, to create a more realistic situation, it was decided to ditch the ordinary educational platforms and move all students onto Slack, an online collaborative platform used in industry. Slack was then used to exchange information and ideas and submit results during the project. The reason for choosing Slack was its basic design with easy to use functions for collaboration between all students on the two courses (using public channels) and between specific groups discussing projects (using private channels).

The third challenge was since the semesters between the two universities differed. The courses started approximately one month apart with the Marketing course starting earlier than the engineering students. It was decided for the marketing students to do individual assignments that could be used by the engineering students later on during this time. The two courses ended at approximately the same time though.

RESULTS FROM FIRST COLLABORATION ITERATION

The first iteration of the collaborative project between Umeå University and Edith Cowan University was carried out in several steps with different degree of collaboration between the students (Figure 1).

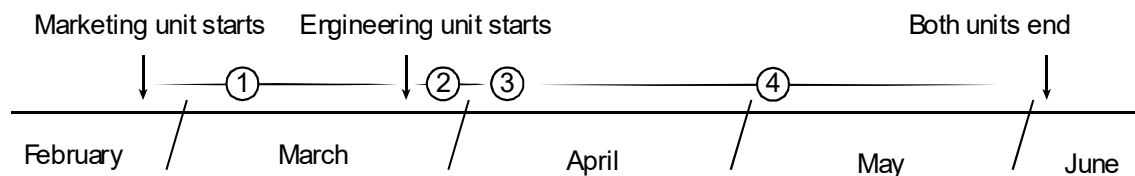


Figure 1. Timeline for the first iteration of the collaborative project.

1. The marketing students formed teams at the beginning of their course and created online public blogs containing information on the topic chosen for the project. The information was drawn from both academic and industry literature relating areas of marketing innovation such as smart home technology, connected devices, online media, gamification and environmental sustainability. The blog post formed both part the marketing students' assessment for the course and the basis for the initial investigation for the engineering students.
2. Later on, the groups formed by the engineering students reviewed the blog posts posted by the marketing students as input for their preliminary research to gather information for deciding on an idea and the need for their mobile application. Linking the assignments between the two courses, but not integrating them made it possible to partly solve the first challenge addressed regarding the dependence between the students. Hence, a situation where students could be assessed on the different tasks independently was

- created. This was a good solution that lowered the fear of being dependent on someone that the student does not know and, hence, created a more secure feeling for the students.
3. After the initial research done within the area, the engineering students created a short document (approx. 1 page) and a short video (Figure 2) describing their proposed idea and app in English and posted it on Slack for the marketing students to evaluate. The video was a complement to the text and was created to more vividly be able to describe the core of their idea in a way that was easy to understand.
 4. During the length of the course, there was ongoing collaboration regarding the development of the mobile applications.



Figure 2. A short video was created by the engineering students to describe the idea and concept of their application for the marketing students.

Analyzing the evaluations by the students on the two courses revealed that they liked the general concept with the collaboration around the project. However, they felt that the setup of the collaboration lacked structure and students on both courses from time to time struggled with the unknowns, as they felt somewhat dependent on students on the opposite side of the planet. However, analyzing the conversations and use of the online communication platform (Slack), it could be noted that the students exhibited skills in finding solutions and workarounds to complete their assessments when they experienced obstacles. The results of the collaboration and discussions among the teachers on the two courses concluded in several lessons learned, from a teacher's perspective, from the first collaboration:

- The unknowns need to be minimized, even if it means overwhelming information at the beginning of the courses. Hence, there is a need to explicitly explain how all parts of the collaboration and the project are going to work and how the students execute their role in each specific part.
- There were an uneven introduction and knowledge about each other since the marketing students got the videos from the engineering students and then “got to know them” through the videos. Hence, there is a need for a supervised real-time online introduction of the students, so all students have a feeling of having similar knowledge about each other.
- The time difference is a major problem for real-time collaboration, but this was part of the challenge. Hence, there is a need to provide the students with more natural real-time opportunities by setting Swedish lectures in the morning and Australia lectures in the afternoon.

- The dependence on material from the other course meant that when deadlines are not met on time, many students are sitting waiting. Hence, there is a need to set strict joint deadlines between the two courses and, foremost, make clear the consequences for the students and the collaboration of failing to meet these deadlines.

The collaboration, and consequently the communication, with students from another discipline, was valuable for the students. During an education program, most collaborations are either within the same group of students with students within a bordering discipline. In this case, the engineering students had to collaborate with marketing students and vice versa. These are students with different background and point of view but with the same goal for the project. Even though this created difficulties in communication, it also generated a more real situation as respect to their future profession. Hence, from a professional point of view, this became an important learning for the students and also something that made the students want to further tighten the collaboration to get a better understanding of the other group of students.

Due to limitation in both time for making the setup for the collaboration and the fact that this was the first iteration, the number of mandatory touchpoints between the students on the different courses were limited. One of the problems that occurred was that since both courses ended at the same time and it was needed to have the final presentations at the very end of the course (to give the students enough time to complete their tasks), it was hard to find time for final feedback between the two student groups. According to the students, they felt that “the collaboration ended in the middle of the course”, since no contact at the end of the project was mandatory. The feedback was instead given by the teachers.

Challenges that arose during this first collaborative project included: (1) stilted exchanges on issues due to time differences, (2) different understandings of cultural and professional priorities and (3) problem in aligning the timing of assessment of the two courses’ requirements. However, benefits to the students included, (1) experience to give and receive feedback to other student groups, (2) experiencing a new and international business culture, (3) experience of actual and real online collaborative work and use of digital collaborative technologies, (4) development of semi-professional online media skills and (5) solving the problems stated above. Furthermore, the engineering students were communicating and collaborating in a foreign language, which further increased the benefits from the collaboration.

RESULTS FROM SECOND COLLABORATION ITERATION

The main objective of the second iteration of the collaborative project was to address the problems that occurred during the first iteration. This was achieved by creating a tighter and more integrated collaboration and by forming stronger bonds between the students at the two universities. The problem with the understanding of the other students was addressed by setting up a formal real-time full class introduction using an online meeting application introducing the collaboration at the same time for both courses. According to the student evaluations, this created a better understanding of “who are the ones on the other side of Slack”. To further encourage the collaboration and to make the deadline stricter, another real-time full class online meeting was held in the middle of the course for discussions and feedback by the marketing students on the engineering students’ applications. Furthermore, real-time discussions between the groups in Sweden and Australia were encouraged during the collaboration but did, unfortunately, not occur to the extent desired. Another issue that was addressed was the problem with the collaboration ending too soon. As described above, real-time interaction was encouraged but was not the preferred way of interacting among the

students. However, more online discussions were noticed on Slack during the latter part of the course than during the first iteration. To further stretch the “visible” part of the collaboration, a final feedback round was held at the end of the courses, which made the collaboration seem more integrated between the courses. This was, however, not done in real-time due to lack of time at the end of the courses.

From the student evaluations and discussions with students during the length of the courses, it was clear that when the initial problems from the first iteration were addressed, the students had comments regarding how the actual collaboration should be set up. The more integrated take on the collaboration increased the motivation among the students to deliver results. Nevertheless, when the collaboration became more integrated, they became aware of their lack of knowledge regarding Slack and the other online collaborative tools used.

When the initial teething problems were addressed it also became clear that the students were prepared to have even more integrated projects between the two courses. While the teachers view has been to keep the courses a little apart to shelter the students from problems that could arise from the collaboration, the engineering students requested even more integrated courses and projects. The challenge will be to create a full integration of the courses and still keep to the regulations of the respective universities regarding assessments and examinations. Learnings from the second iteration include:

- A more thorough introduction to Slack and the other online collaborative tools used should be offered to speed up the collaboration at the beginning of the units.
- Even more introduction to the other group of students and what they can expect from each other should be set up. This could be done by adding an introduction with each student group (i.e. each group of engineering students working with a group of marketing students). By supervising individual introductions, it should be possible for every individual student to be more in focus than during the class introduction.
- Better solution to how to set up projects when the semesters differ between the participating universities’ need to be discussed. This is mainly to make the most of the students’ time during the length of each student’s course.

ONGOING DEVELOPMENT

Even though evaluating and analyzing the project among the teachers involved in the collaboration revealed several challenges with the collaboration and, consequently, made the two individual courses more complicated to run, all teachers involved believed this type of international collaborative curriculum benefit the students to a great extent (cf. Chang & Lee, 2013). It is also believed that this gives the students that do not engage in exchange studies an international perspective of both their education and their future profession while still on their home turf. While new challenges have constantly emerged, there have been solutions to the initial challenges, which have made it possible for the students to focus on the actual collaboration and not on solving unrelated problems.

This collaborative project is ongoing, and the collaboration is further developed during spring 2020 with a third iteration of the collaborative project during March-June 2020. The challenges that are currently being addressed mostly focus on aligning the work among the two student groups to maximize the use of the students’ time. In the next iteration, the marketing students will not only provide background information but also provide timely feedback on the engineering students’ ideas. This third iteration became a real-time test of the idea since the

Covid-19 global pandemic not only made it impossible to travel abroad, but also made all students to work completely online for both courses. During this iteration, both the students at Umeå University and ECU was not allowed to take part in campus education and both courses were quickly transformed into online courses. This iteration is yet to be completed during early summer 2020, but many of the issues discussed in this paper have been addressed. The collaboration will be further developed during fall 2020 and during the fourth iteration in 2021, the idea is to make the marketing students to also come up with ideas during the four weeks they work before the engineering students start their course. In this way, the marketing students will become a client and the engineering students will work as a developer team. Additionally, the need to increase the spontaneous interaction between students and the number of different mandatory touchpoints between the engineering and marketing students will be addressed. Furthermore, the long-term goal is to develop more common assessments and common evaluation criteria based on both universities' regulations.

CONCLUDING DISCUSSION

The experience from the global lockdown during spring 2020 made it clear that it might not be possible to take international travel and, hence, the possibility for students to engage in exchange studies, for granted. It will be important that the issue with how to give students international experience without having to travel abroad is further raised at universities around the world. This paper presents insights and experiences from an international collaborative project to give students high qualitative collaborative cross-disciplinary international experience without having to leave their home turf.

Even though this project will be further developed, the initial results clearly show that by integrating courses between different countries and disciplines, it is possible to create a study environment that strengthens the students' ability to work both together as a team and towards other teams with other assignments but the same general mission (CDIO Syllabus 3.1). Having created a situation utilizing online collaborative tools with different degree of interaction (e.g. video meeting, voice call, chat, bulletin board, etc.) strengthen the students' ability to communicate (CDIO Syllabus 3.2). Working together with students in another country will, most certainly, also create a situation of communication in a foreign language for one part of the dyad (CDIO Syllabus 3.3). Setting all this up in an international perspective with an interdisciplinary counterpart addresses issues as cultural differences, the roles of the engineer in a larger context and also touches upon the impact of engineering on other parts of the economic and societal system (CDIO Syllabus 4.1).

It is to be believed that the importance of an international and global perspective on engineering education will continue to become increasingly important. However, it will also become important to incorporate this perspective in many of the courses that we offer to our students. This said, from a sustainability perspective, both in terms of the environmental impact, but also in terms of being able to create a system that can be continuously used in education is just as important. The objective of this paper is to describe one turn on creating a sustainable way of giving our engineering students an international perspective of their education and their future profession.

Furthermore, it is clear that having experience from working with international online collaboration and the knowledge about the tools necessary are competitive advantages in times when both professional collaboration and education are quickly moved online, such as

spring 2020 and the Covid-19 global pandemic. Having the necessary technical and didactical knowledge among the teachers involved made the transition smooth.

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BIOGRAPHICAL INFORMATION

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