

Three years of an intensive Programme: Experiences, Observations and Learning Points

Jens Myrup Pedersen^{*}, José Manuel Gutierrez Lopez^{*}, Marite Kirikova⁺, Lukasz Zabłudowski[#] and Jaume Comellas[§]

^{*} Department of Electronic Systems, Aalborg University, Denmark

⁺ Department of Systems Theory and Design, Riga Technical University, Latvia

[#] Institute of Telecommunications, UTP University of Science and Technology, Poland

[§] Department of Signal Theory and Communications, Polytechnic University of Catalonia, Spain

Email: jens@es.aau.dk, jql@es.aau.dk, marite.kirikova@cs.rtu.lv, lukasz.zabludowski@utp.edu.pl, comellas@tsc.upc.edu

Abstract

This paper summarizes valuable experiences and learning points from three years of the Erasmus funded Intensive Programme on “Implementing Europe’s Future Broadband Infrastructure”. The programme consisted of a course held each year 2012-2014 during two weeks of July, where 30-35 students and 10-12 teachers from the 4 participating universities would meet in the location of one of the partner institutions. During the three years, the programme was each year adjusted according to the observations and evaluations from the previous year.

The course was organized as a week of course modules, followed by a week of project work. The topics of the first week were defined to support the project work in the following week. The projects were based on real-life problems proposed by companies, and had to be solved in student groups with a mix of nationalities and educational backgrounds.

Among the key learning points, we can highlight the importance of clearly communicating learning goals as well as motivations for the students to work problem-based and across traditional disciplines. Also, having short time to get a group from four different universities work together it is important to actively encourage (or enforce) the students to mix and work together throughout the course activities. Finally, we found that the model of combining course modules and projects worked well, especially if active learning approaches were used in the course modules.

Keywords: Problem Based Learning, Internationalisation, Intensive Programmes, Cross-Disciplinary projects.

1 Introduction

In the recent years there has been increasing focus on modernisation of higher education in Europe. This is for example described in (European Commission, 2011) which identifies a number of targets, including improving the quality and relevance of higher education, promoting mobility and cross-border cooperation, and linking higher education, research and business. In 2012, we initiated a collaboration project named “Implementing Europe’s Future Broadband Infrastructure” (fbi.es.aau.dk, 2014) in the framework of Erasmus Intensive Programmes. This was partly inspired by the challenges as outlined above, but also was done in order to give the possibility to work together for students from different countries in a truly international environment – i.e. an environment without dominance from certain countries or regions. The overall idea of the project was to bring together students and teachers representing different fields of broadband networks and network planning, give an overview of the most important elements in the whole value chain of planning future broadband network infrastructure, and let students from the different disciplines work together on projects by solving concrete business challenges proposed by companies. This way, we aimed to give the students the following experiences:

- Working together across disciplines, and apply their knowledge and expertise in a context where other students would contribute with their knowledge and expertise.
- Working together across different cultures and learning traditions.
- Working together on projects, solving real-world problems.

It also was a good opportunity for teachers to exchange knowledge, experiences, and best-practice regarding teaching methods, with a focus on projects and Problem Based Learning (PBL). It was also crucial to give the involved teachers an insight to PBL which is quite different from the classical lecturer role (Dahms, 2014).

This paper describes the experiences throughout the project and is organised as follows. Section 2 gives an overview on how the project was designed and organised, including a presentation of the expected learning

outcomes, course structure, and examination. In Section 3 we present the results extracted from student evaluations, followed by Section 4 that contains a presentation and discussion of the key observations and lessons learned. Section 5 concludes the paper. The main contribution of the paper is the presentation of practical experiences and learning points during three years of the Erasmus Intensive Programme.

2 Project design and organisation

The intensive course itself took place during two weeks in the summer each year in one of the participating countries. In 2012 it was organized in Aalborg, in 2013 in Bydgoszcz, and in 2014 in Barcelona. Each year the Erasmus support would cover the participation of 25 travelling students, and we would accommodate for up to 10 local students (the number of local students varied from 3 to 10 during the three years). The stipends from Erasmus would cover all costs of travelling, accommodation, and subsistence during the two weeks for the travelling students, whereas for the local students the funds were limited to cover the joint meals. In order to facilitate integration and social interaction, all accommodation and meals were organized jointly.

2.1 Learning objectives

With the students having diverse background and learning traditions, it was important to define explicit learning objectives that could be communicated to the students, along with guidance on how evaluation would happen. This way the expectations were aligned and uncertainty avoided, allowing the students to focus on the programme. The learning goals established were the following.

- The students will obtain an understanding of the whole value chain of planning future broadband network infrastructures, enabling them to put their own fields of expertise in a broader extent.
- The students will become familiar with selected real-world problems, and collaborate with students having different backgrounds to develop innovative solutions across traditional disciplines.
- The students will obtain knowledge of different teaching methods, and reflect on their own learning styles.
- The students will improve the competences with respect to entrepreneurship in relation to network planning, in particular by better understanding the relations between technology and business challenges/opportunities.

The first week consisted of mainly course modules. In the second week, the students were working on problem based projects in groups and eventually ended up with (1) a 30-minute presentation that was also handed in as project documentation and (2) a short document with their reflections about the learning process during the project work. The exam was based on an oral presentation and questioning session.

2.2 Course design and programme

The course was generally designed and planned in the same way during all three years, with smaller adjustments regarding both course content and the didactical aspects. In the following we present the course as it was given the first year. Adjustments in year 2 and 3 are explained in Section 3. The general idea was that of the Aalborg PBL model (Kolmos et al., 2004), where the course modules provide knowledge supporting the students in carrying out the problem based project work. Also, it was inspired by initiatives at the other partner universities, such as the CDIO initiative (Crawley et al., 2007) being implemented at the School of Telecommunication and Engineering in UPC and the experience of RTU with self-organized student groups working on real-world problems (Kapenieks et al., 2002).

The students arrived on Saturday (day 1), and left again Sunday (day 16) two weeks later. There were no or little activities on these two days. Sunday (day 2) was spent on teambuilding and get-together activities, in order to facilitate interaction between students from different universities and "break the ice".

After this, the first week Monday-Thursday (days 3-6) was mainly focused on course modules including problem solving in groups. In general, one such module was given in the morning session, and another module in the afternoon session. Each module would include teacher presentations as well as group work and problem solving in terms of both larger problems to be solved in the groups, and small peer discussions

during the lectures: The design was left to the individual lecturers, but experiments with active learning were encouraged. There were modules regarding technical aspects of broadband networks and applications, as well as business-oriented module. One of the last modules was a guest lecture with a lecturer from industry presenting a topic linking business and technical aspects, and demonstrating how both aspects play a role in handling a specific case. All in all, the topics of the modules were chosen to give the students a good overview of the problem domain they would work on in the second week.

Friday (day 7) in the first week served as the introduction to the project work, including presentation and selection of problems to work on, as well as introduction to carrying out problem based project work with a focus on collaboration in international groups. The project groups got the opportunity to discuss their project organisation, also made a written collaboration agreement between the group members. Especially since many of the students were unfamiliar with PBL, a good introduction to aims, methods, principles and expectations was deemed crucial for success (Du et al., 2007).

The projects were proposed by companies, but in collaboration with the course responsible in order to ensure a good fit with the learning objectives. The project definitions were inspired by (Rienecker et al., 2013), but modified to suit the short project duration. The student groups were pre-determined by the teachers and formed to ensure diversity both technically, country wise, and with respect to gender representation. In addition to ensure such diversity, the main reason for the pre-determined groups was that we wanted to avoid social tension during the course. Each group was free to choose among the different project proposals by handing in a prioritized list, and the projects would then be assigned fulfilling the student wishes as much as possible while also ensuring diversity in the projects to be carried out.

While the weekend (days 8-9) was allocated mainly for joint social activities and excursions, Saturday morning was devoted to an "Entrepreneurship workshop", focusing on practical hands-on use of the Business Model Canvas (Osterwalder et al., 2010).

In the second week Monday-Thursday (days 10-13) the students were working on the project in groups of 4-5 students. They organized and planned the work and tasks themselves, being supported by the supervisor (one teacher) that was assigned to each group. Moreover, since the participating teachers represented different disciplines including knowledge on PBL, they were able to also draw upon other teachers as project consultants, and on representatives from the companies, which had contributed with the project proposals. During both weeks, workshops were held among the teacher to discuss teaching and supervision. The project presentations and examinations took place on Friday in the second week (day 14). One hour was allocated for each group, and was organized by a presentation, questioning and discussion session with questions from the teachers, and then a pass/fail evaluation of each individual student. After the joint questioning and discussion session, it was also possible to have a more open discussion with questions from other students. On Saturday (day 15) the only organized subject-related activity was the evaluation session, with consisted of both qualitative feedback and collection of quantitative data through questionnaires.

2.3 Evaluation

During the two first years, on the last day of the course, the students have filled out a questionnaire to evaluate their experiences, based on a template provided by Erasmus. In addition to the questionnaire, there has been an evaluation session with the possibility to come with more qualitative comments. In the third year, Erasmus changed the evaluation procedure so all students would receive an electronic questionnaire created by the Erasmus Mobility Tool in the days following the course. Unfortunately, some of the questions were different from the previous years, and also the scale was changed from "1-5" to "1-4".

3 Evaluation results and course adjustments

Each year the results of the course were evaluated by students and teachers. The results of student evaluations and changes in the course delivery are presented below for each year. The practical aspects were also evaluated, even though the results are not included here. We have also not included the evaluations of the individual lectures due to space limitations.

3.1 Year 1 (2012)

The main evaluation points from the course in 2012 can be seen in Tables 1-2.

Table 1: Which factors motivated you to participate? (scale 1-5). Average numbers for all students.

	Danish	Latvian	Polish	Spanish	All
Academic	3.7	4.6	4.0	3.8	4.0
Cultural	3.7	4.4	5.0	4.3	4.5
Practice of foreign lang.	2.7	4.2	4.9	4.2	4.3
Friends living abroad	1.3	3.6	1.2	2.6	2.1
Career plans	2.3	4.0	3.9	3.7	3.7
European Experience	2.7	4.6	4.7	4.6	4.4

Table 2: Judgement of outcomes (scale 1-5). Average numbers for all students.

	Danish	Latvian	Polish	Spanish	All
Academic/learning outcome	2.0	4.2	4.4	3.6	3.8
Personal outcome	3.7	4.4	4.9	4.5	4.5
Help in finding job	2.0	2.6	3.7	2.7	3.0
Help in future studies/career	2.3	3.6	4.4	3.6	3.8
Overall evaluation	4.0	4.8	4.3	4.7	4.5

Table 1 illustrates that the main motivations were academic and cultural, and that especially the students from outside the hosting country (Denmark) were also highly motivated from the European Experience. The non-Danish students seem much more motivated than the students from outside Denmark. In Table 2 it is also clear that the travelling students have judged their personal and academic outcomes to be higher than the Danish student. Generally the personal outcomes were rated higher than the academic outcome.

We also had the following important observations that were not included in the quantitative evaluations:

- The students were eager to get to learn new people from other countries, but on many occasions still had a tendency to form "national cliques" – e.g. during meals, seating for exercises, and social activities.
- For the lecture evaluations there was a tendency that the technical lectures were rated higher than the more business-oriented lectures. According to the evaluations, it was difficult for them to see the purpose of the business-oriented lectures especially in the beginning of the course.
- During the presentations and exams some students got extremely nervous, probably because of the exam pressure combined with making their first presentation for a larger audience in English.
- While the students were generally satisfied with both projects and lectures, it was a challenge to find the right level of lectures for such a broad audience with very diverse backgrounds.

With these evaluations and learning points in mind, the program for the second year was adjusted:

- The value of understanding the problem domain from both business and technical aspects were made clearer from the beginning of the course, in order to increase the motivation and satisfaction of the students for the business aspects. This was expected also to increase the academic outcomes.
- To facilitate more integration and communication across national cliques, randomized seating was introduced partly already during the first year (in the last modules of the first week). This was taken a

step further by using pre-assigned seating during all lectures, and combined with problem solving in groups of different sizes, to ensure that all students would have the chance to get to better know each other. We would also make an effort to have both visiting and local students accommodated together – which was an option due to lower accommodation costs in the 2nd year due to the location.

- We would focus more on training the students to make good presentations, e.g. through video training.
- For the lectures, it was decided to put even more focus on active learning and peer learning through e.g. exercises and mini projects. In this way, it was expected to increase the learning outcome for students at different levels, also because the students could learn from each other.

3.2 Year 2 (2013)

The main evaluation points from the course in 2013 can be seen in Tables 3-4.

Table 3: Which factors motivated you to participate? (scale 1-5). Average numbers for all students.

	Danish	Latvian	Polish	Spanish	All
Academic	3.6	3.5	4.4	3.5	3.8
Cultural	4.8	4.5	3.9	4.4	4.4
Practice of foreign lang.	2.8	4.2	4.4	4.4	3.9
Friends living abroad	2.6	3.7	3.2	3.0	3.0
Career plans	3.3	4.6	3.3	3.0	3.4
European Experience	4.6	4.8	3.4	4.0	4.1

Table 4: Judgement of outcomes (scale 1-5). Average numbers for all students.

	Danish	Latvian	Polish	Spanish	All
Academic/learning outcome	3.2	4.4	4.1	3.5	3.7
Personal outcome	4.2	4.5	4.5	4.4	4.4
Help in finding job	2.7	3.8	3.2	2.4	2.9
Help in future studies/career	3.4	4.2	3.5	3.1	3.5
Overall evaluation	4.7	4.8	4.1	4.5	4.5

Compared to the first year, the motivations (Table 3) were quite similar, with the overall judgements being a bit lower. However, in general the local participants had a higher motivation than in 2012. Some of the ratings, e.g. "European Experience" and "Cultural" seem a bit lower than the previous year, but this can be explained by the fact that there were more local participants (10 instead of 3), and that the local participants rate these points lower than those who travel. While these quantitative evaluations were very similar to the numbers from 2012, we made the following observations:

- The business-oriented lecture at the end of week one was rated higher than in the previous year. The entrepreneurship workshop was not rated in 2012, but in 2013 it received one of the highest ratings during the week. We therefore believe that we managed to increase motivation and understanding of the cross-disciplinary work. However, this was not yet established when the course started, and the first lecture (which was more business-oriented) was rated at the same level as in 2012.
- The fact that all students, including local students, stayed in the same accommodation, made it much easier to integrate the local students in all activities, which is also reflected in the evaluations from the local students. The efforts to integrate students during lectures also worked out well.

- The focus on preparing good presentations worked: The presentations were better and more fluent than in 2012, and the students were more comfortable and had a better experience.

With these evaluations and learning points in mind, the program for the third year was adjusted:

- We decided to put even more emphasis on the value of working across disciplines, and especially the value of understanding the business and entrepreneurial aspects, from the beginning of the course. Therefore, as a new element, we would add an additional workshop focusing on entrepreneurship already on day 2 (Sunday before the course itself starts). Moreover, the teacher responsible for entrepreneurship would stay throughout the course, to participate in discussions during the first week, and to help focus on entrepreneurial aspects throughout also the second week.
- We decided to increase the video training for presentations, and combine this with pitching entrepreneurial aspects. This was done concretely by ending the afternoon sessions in the second week with a "status pitch" from each group, which was recorded by video and evaluated with the presenter. Moreover, we had several cameras that the students could use for practicing throughout the week, and the opportunity to receive feedback both in groups and one-to-one.
- As an experiment, we would also increase the diversity among students by including students with a more entrepreneurial background as well as students with a bioinformatics background in 2014. This turned out to also give a more equal gender representation among the students.
- We would continue experiencing more with active learning during the lectures.

3.3 Year 3 (2014)

The main evaluation points from the course in 2014 can be seen in Tables 5-6. It should be noted that this year a scale (1-4) is used, which is different from the previous years. However, in the table we have normalised the numbers in order to make them comparable. Also, the local students have not received or filled in the questionnaires, which is all due to changes in the Erasmus forms distributed to students.

Table 5: Which factors motivated you to participate? (Normalised to 1-5). Average numbers for all students.

	Danish	Latvian	Polish	All
Academic	4.2	4.3	5.0	4.6
Cultural	4.6	4.6	4.9	4.7
Practice of foreign lang.	3.3	3.9	4.9	4.1
Career development	3.7	4.1	4.6	4.2
European Experience	4.1	4.3	4.9	4.5

Table 6: Judgement of outcomes (normalised to 1-5). Average numbers for all students.

	Danish	Latvian	Polish	All
Academic/learning outcome	4.5	4.7	5.0	4.7
Personal outcome	4.5	4.7	5.0	4.7
Help in finding job	3.1	3.9	4.2	3.7
Help in future studies/career	3.8	4.3	4.7	4.3
Overall evaluation	5.0	4.7	5.0	5.0

Some interesting observations regarding the last year: Table 5 shows that the motivation regarding the academic aspects is higher in the last year, but also that the judgement of the academic outcome has

increased to the same level as the judgement of the personal outcome. The latter has actually increased from 3.7 to 4.7. Even if the local students did not answer the questionnaire in 2014, this indicates a significant improvement. We believe that, at least partly, this can be related to the strong focus on the value of cross-disciplinarity from the beginning to the end of the course – including being very explicit about the learning objective. The increased use of active learning during the first week might also play a role, and we can see from the evaluations that it was appreciated by the students; especially an IT-tool that was used for voting during the lectures received many positive comments. Also, the focus on making video presentations seemed successful, and can have contributed to the higher judgement of academic/learning outcome.

4 Observations and learning points

The intensive programme has been well received by the students, and received good evaluations. Based on the qualitative and quantitative feedback received, there is no doubt that the students have learned a lot:

- Academically, related to the technical subjects
- Regarding collaboration skills in an interdisciplinary and international environment
- Regarding skills related to bring their competences into play when solving real-life problems

During the evaluation of the project, we have made the following observations and learning points, which we believe will be beneficial in future projects that have a similar scope:

- In general the setup with combining courses and projects worked well. However, it is a challenge to give lectures at an appropriate level when the students attending have very diverse backgrounds. This is a problem also encountered in our usual classes, e.g. when having guest students from a broad, or when students from different B.Sc. educations study for the same M.Sc. degree. We had good experiences with integrating active learning approaches and mini projects into the lectures, since this allowed for peer learning that was beneficial even for learners at different levels. However, in the future more personalised approaches to learning could be useful, something that could be implemented using blended learning.
- While the subject-related parts of the course were important, we believe that much of the value was created through the intensity of the program: The students (and teachers) spend two weeks together almost 24/7. Getting to know each other so well also facilitated a good learning environment.
- In our experience it is important to be very explicit concerning learning objectives and goals, and to motivate the multidisciplinary approach. Even if we felt it was clearly communicated, some students would still have an attitude that the non-technical aspects were not relevant for them. Making an effort on doing so, and doing it from the beginning and in 2014 also throughout the course, was probably one of the reasons that we succeeded in increasing the rating of the business-oriented lectures and the overall judgement of academic outcome.
- Two weeks is short time, and it is important to get the students together as a group quickly. For this, the team building activities were good icebreakers. Also mixing students throughout the course – both for group work and seating during lectures – turned out to be a surprisingly efficient way of getting students to know each other and avoid national cliques, leading to both personal and academic gains. This approach was also well received by the students who appreciated and even encouraged this approach.
- It was a challenge to integrate local students. One issue was related to the lack of funding for local students, implying that in most cases they could not be accommodated with the students travelling. Also the local students are in their usual social environment, which makes it difficult for them to become equal part of the group. If at all possible, we would recommend hosting everyone together.
- For communication during the course, we discussed different learning platforms but ended up creating a Facebook group. The immediate advantage was that the user interface was known by most students and teachers, and that it could run on most devices and platforms, including computers, tablets and smart phones. Thus, for spreading information regarding both subject-related and social activities, it was possible to reach all students quickly. An additional advantage was that it also made it easy to create and sustain friendships, both at an individual basis and by keeping the group active after the course.
- While Aalborg University as a PBL university has a strong tradition for students working on project proposals from companies, this approach was not widely used among the other universities. We

increased the number of proposals from non-Danish companies during the three years, but also realized the importance of being very explicit on what exactly was required from the companies, and what they could expect from the students.

- Also regarding the projects and project proposals, we found it somewhat challenging to identify good problems, where the students could come up with reasonable solutions from a workload corresponding to four days of work, and where all students felt they could contribute across backgrounds. Eventually, we developed a common understanding of "concept development" that fit to the time frame and student backgrounds. However, we found it crucial that the project proposals were truly problem oriented, and not just a de facto list of tasks for the students to carry out. It is also important that all supervisors are comfortable with working on problem based work, and has access to other people with PBL experience.
- As a last observation, it was a pleasure to see how the problem based project work motivated the students beyond our expectations all through the three years. During the last days, many groups would spend at their own initiative (and while being in a good mood) long afternoons and evenings on working on projects and presentations.

5 Conclusion

This paper has described our experiences during 3 years of an Erasmus Intensive Programme with focus on letting students work together on projects based on real-world problems across disciplines, nationalities and cultures. The student evaluations were presented, along with our experiences and learning points and it was shown how the evaluations and observations lead to adjustment during the 3 years.

Overall, the student evaluations and judgements of outcomes were high. During the first years the personal outcomes were judged higher than the academic outcome. In the third year we made a stronger effort in making clear objectives and motivating the interdisciplinary approach throughout the course, which might be one of the reasons that the academic outcome was judged higher this year.

The main contribution of the paper lies in the observations and lessons learned, which we believe can be valuable in future projects, e.g. in the scope of Erasmus+ projects as well as in project based teaching and learning activities that enrol in their courses students of different nationalities and backgrounds.

6 References

- Crawley, E.F., Malmqvist, J., Östlund, S. & Brodeur, D. (2007). Rethinking engineering education: the CDIO approach, Springer.
- Dahms, M.-L. (2014). Problem Based Learning in Engineering Education. in V Villas-Boas & O Giovannini (red), Attracting Young People to Engineering: ALE 2014. Associação Brasileira de Educação em Engenharia.
- Du, X., Dahms, M.-L., Jensen, L.P. & Kolmos, A. (2007). Introducing PBL to Foreign Students in International Engineering Programs. in Zayegh, A. Sojcevski, A., Perera, C. & O., A.M.T. (red), Proc. of the International Conference on Engineering Education and Research, Melbourne, Australia, 2007. Victoria University.
- European Commission (2011): Supporting growths and jobs. An agenda for the modernisation of Europe's higher education systems. The European Union.
- fbi.es.aau.dk (2014): Future Broadband Infrastructure website. <http://fbi.es.aau.dk>
- Kapenieks A., Kirikova M. & Zuga B. (2002). Teamwork in e-learning development projects in teleworking environment. In: Proceedings of the TELEBALT'2002, ISBN 9955-9612-0-1, pp. 104-106.
- Kolmos, A., Fink, F. K., Krogh, L. (2004). The Aalborg PBL Model: Progress, Diversity and Challenges. Aalborg University Press.
- Osterwalder, A. & Pigneur, Y. (2010). "Business Model Generation", John Wiley & Sons, New Jersey.
- Rienecker, L., Jørgensen, P. S. (2013). The Good Paper. Samfundslitteratur.