

Internationalization of undergraduate group projects

Martin J. Pitt (m.j.pitt@sheffield.ac.uk)

University of Sheffield, UK

Abstract: For more than ten years students have been set projects in a variety of foreign countries and asked to consider relevant local factors in making their design decisions. This has been carried out in one-day exercises (where the whole class is in groups of 6 and each set a different country) and in extended 30 credit design tasks. The students have to research the country in some depth and with some exercise of professional judgment in order to determine a process or product to be produced there, including a suitable location. This allows the exploration of business markets (local and international, present and potential) in deciding the scale of production. Other issues which can be explored are environment, sustainability and transport. Local weather and certain cultural issues may be important. The general method and some examples will be given.

Introduction

The desirability of engineering graduates having an international perspective was well argued by Irandoust & Sjöberg (2001) who wrote

“National economies are increasingly integrated into a global economy. Major companies act world-wide. They need employees with a more internationally viable education. The need for improved communication and the ability to understand different countries and cultures increases.

....Already from purely economic considerations, employers need to recruit staff who can deal with the companies’ interactions with different markets and customers. Universities will need to address these issues also from an ethical perspective, to equip students with attitudes that support a positive and sustainable global development, even if we do not always know what that would be. Understanding social and political circumstances thus becomes important.”

In addition, the demand for engineers to consider sustainability requires more than a limited national perspective (Engineering Council UK, 2009).

However, a 2008 study (Hyland et al., 2008) of UK students reported “*One of the most striking findings of this project was the lack of engagement of home students with internationalisation either personally or pedagogically.*”

Of course visiting foreign students provide some benefit in appreciation of the variety of human beings, and a few students may visit another country as part of an exchange scheme. However, the task is surely to give all students some insight into the practice of their profession in other countries, and the following describes a way this has been achieved by incorporating it into existing project work.

While the experience is of a chemical engineering department, it is believed that it could be easily used in other subject areas, particularly in modules related to business or product design. It has been adopted both to promote an awareness of international issues in engineering, but also to provide variety for groups who would otherwise be doing the same project. Producing a product or carrying out a project in a different country means dealing with differences in economic, technical and human issues which are very relevant to professional practice.

The Design Project

It is usual in chemical engineering degrees for students in their 3rd or 4th year of study (UK BEng or MEng final year) to carry out a major design project. This is typically done in a group, and consists of designing a process to manufacture a chemical, fuel or a chemical related product. The general literature describing such projects (particularly in the UK and USA, but also Australia and some other

countries) almost invariably prescribes a plant in that country. In fact the country is commonly not stated but there may be a note in the project brief to “assume UK/US/etc conditions apply”. Students can thereby use familiar local information about weather, transport, currency, labour practices etc which may be relevant.

Where all groups are given the same project, there is an issue as to the uniqueness of the resulting reports, which is important as it makes a major contribution to the degree classification. The alternative is to have each group doing a different project with a different supervisor. With increased class sizes and limited staff availability this can be difficult to achieve. There is also a problem of fairness – are the projects equally easy or challenging?

The International Design Project

At the University of Sheffield chemical engineering students are required to do a 30 credit design project in their third year. In order to meet the learning outcome of ability to work in groups, this is done initially in a group of 5 or 6 who produce a group report (20% of the whole assessment) for which they all get the same marks. The group also makes a presentation for which they are individually marked (10%). This is followed by a detailed individual design report which makes up the rest of the assessment (70%).

Taking this year’s numbers, the same basic project is given to 36 students (half the class) divided into groups of 6. (The other half does a different project.) There are 4 academic supervisors for the project, which means that students have access to a supervisor familiar with the project when one or two staff are away for any reason. A VLE environment is used to share materials, and industrial visitors are used when possible.

Examples of projects in recent years are:

- Manufacture of hydrogen from natural gas
- Manufacture of biodiesel from local plant materials
- Manufacture of vinyl chloride for PVC

Each group is given the product and a country in which it is to be based. For the hydrogen project, the countries were Chile, Nigeria, Norway, Pakistan, USA, and Venezuela. In this particular project the raw material is defined by the locally available natural gas (which has a different composition and therefore requires different processing). However, in most cases the raw materials have not been specified: it is for the students to look at resources available in the country or which can be imported. They also have to decide the location and the production output based on a feasible market.

The students produce a group report giving (relevant) background about the country and their proposals for the raw materials (what and sources) the annual output (based on a proposed market) and the location (based on transport, distance to market etc.) Issues of cost, sustainability and environmental matters are addressed. Some of the considerations are best illustrated by example.

Some Examples

These projects can be very topical. The China group proposed to provide biodiesel for public transport in Beijing for the Olympics. Most biodiesel groups decided that it was better to find a single large customer such as a major bus company in Spain, or haulage contractors in Kenya, and size production accordingly. It was necessary to find out about the climate and what plants were suitable. The Egypt group felt it was important not to compete with food production and chose *Jatropha* bushes which can be grown on agriculturally poor soil and will not be stolen for food by poor people. They considered the amount of land which would be required and found suitable locations for the customer, the process plant and the farms, including return of waste for fertilizer and minimizing transport costs.

New Zealand is geographically isolated, and imports PVC, so in the vinyl chloride project the group decided to size production for the home market. By contrast Canada has a border with the USA and can consider it as a source of raw materials and a potential market. As PVC is used extensively in buildings there is an expanding potential market in developing countries such as South America, and the Argentina group thought they could both displace imports and export to other nearby countries.

Generally speaking, groups went far beyond anything they had been formally taught in trying to understand the local situation and the possible impact of their project both good (bringing employment and wealth) and bad (affecting the environment or providing some danger). For costing they had to

decide what currency to work in, and how to translate historical data from the UK or USA. Some went as far as to identify an exact location for the plant and to include local incentives such as initial lower taxes.

International Posters

A variation we have done in some years is to get the group to produce a poster instead of a presentation about their proposed process. This has the advantage of producing a display with several functions. It allows all students to see how the same task has different considerations and slightly different solutions in different countries. Thus learning outcomes are not limited to the project group, but are more widely appreciated among the class as a whole. Viewing last year's posters gives some guidance and encouragement to this year's students. It is suggested that this could be adapted to other subject areas – getting students to research topics relevant to their degree which may have practical, cultural or economic differences in different countries.

The One-Day Project

In this students are put in groups and given one working day (or any other convenient but short time) to produce a group report. Again it is the same product but in different countries and they have to research, abstract and summarize relevant information about the country concerned. The same product is given to the whole of the class (72) because there is no time to get into the technical details of production. Some degree of discussion between groups does no harm as they all have different countries.

This has been successful as a preliminary to an extended group project. It basically demonstrates to students what they can achieve in a few hours if they actually get on with it. Faced with a long project the student tendency is to spend excessive time just accumulating information and weblinks. Here they are forced to decide what information is important and when to move on. The groups tend to divide up the work and interact fairly frequently, which is good practice for later on.

Foreign Students

About a quarter of our class are from other countries. The general practice is not to assign a student to a group based on his or her home country. (However, there is nothing to stop the Nigeria group asking a Nigerian student in another group for insights.) The exception is with Exchange students who are here for only one year and sometimes find it difficult to fit in with an established class. By creating a group for that particular country, the group will immediately engage with the exchange student, who is in turn encouraged to participate. I have sometimes seeded a group with a student with a common language, for example an Arabic-speaking student for an Arabic country other than his or her own. Such a student is able to translate web pages and give some insight into culture. This has proved successful in bringing out some reticent, lower-achieving students by giving them importance within the group which they would not otherwise have. Likewise, when a European exchange student comes from a country which is not suitable for some reason (or when there are several) they may be assigned to a project on another country with the same language and help translate web pages.

Staff Usage

Compared with a previous system in which each group did a different project supervised by an individual member of staff, this provides a useful redundancy. It is possible to use fewer staff as supervisors, and the absence of an individual academic for any reason does not mean that the group has no-one to turn to. We noted in the past that individual supervisors tended to repeat projects, and reports could be passed on by students from year to year. If we do decide to repeat a project topic it will be for different countries and after a period of at least five years, reducing the chance and value of such student legacies.

A minor practical difficulty is that the project topic may not be familiar to all the academic supervisors, but one academic is responsible for taking the lead and preparing the others. Of course, they may not be familiar with the countries, but this is not the point. They are there to provide support for the process of finding out and the technical development, not information about the country.

Choice of Countries

There are quite a lot of countries in the world, so it has not so far proved difficult to make a selection. Of course the project must be feasible and preferably plausible, but with technological developments and globalization, it is conceivable to make almost anything anywhere and the need for engineering is universal. By taking a mix of countries with different climates (e.g. Poland and Qatar) varying degrees of industrialization, with and without access to the sea etc, the same notional project can have quite different technical challenges for the design part.

Conclusion

Setting groups of students the same basic project but in different countries has proved effective in providing variety and interest for students and staff. The less able students have been provided with some awareness of the practice of their profession in other lands, and some exposure to issues such as development and sustainability. The better students have been able to exercise their curiosity and creativity. It seems a practical way to achieve internationalization of the curriculum in a demonstrable way and without needing to take time from the purely technical part of engineering education. We find that up to 6 groups of 6 students with 4 joint supervisors are suitable for an extended technical project but that a whole class can be given the same project for a one-day exercise.

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