Sharing Teaching and Learning Experiences – Brain Gain Program

Ruza Ostrogonac – Seserko & Petar Santrac

The University of Western Australia, Perth, Australia
The University of Novi Sad, Serbia and Monte Negro

ABSTRACT: There is often big gap between the engineering curriculum in developed countries (DC) and that in less developed countries (LDC). This is due to the lack of digital resources to follow the new teaching and learning methods used in DCs; and the political instabilities in some less developed countries. The conflict in the former Yugoslavia, which has started in 1990, has left universities in the newly formed states in a very poor state. Large numbers of teaching staff have left the region, and there has been a continuing lack of resources. There are a number of different support programs around the world that are trying to reduce the gap in engineering education between developed and less developed states. One of them is World University Service Austria (WUS). They are inviting qualified academics originating from LDCs to lecture courses, which are not available in their home universities. The first author worked for 20 years at University of Novi Sad, Serbia and Monte Negro. From 1996 she has worked at the University of Western Australia. As part of WUS program she was invited to be a guest lecturer at her old University in South Eastern Europe (SSE). The paper will present the results of this activity.

INTRODUCTION

Engineering education in Serbia has a long tradition, since 1846 when the first Engineering School was established in Belgrade. The German educational system has been the role model for engineering curriculum in this part of Europe. Unfortunately not many changes have occurred in curriculum or teaching methods in the last couple of decades and few attempts to adjust to the new needs of Industry and to move towards the globalization of engineering education. The last war in this region caused even deeper crisis, leaving universities in a very poor state. The Serbian higher education structure is not very efficient. There is an enormous amount of duplication in administration and teaching. Each course is run by a lecturer who writes a text book for the course, which is then the only resource the students are required to use. Academic pay is very low compared to their colleagues in DCs. Courses are very knowledge intensive and have not been changed for decades. The average time to complete a degree is often more than double that in other parts of the world, with students often reaching their mid-twenties before they graduate with a bachelor’s degree. Poor infrastructure and teaching standards are additional problems which universities in this country are facing. [1]

There are a number of different support programs around the world that are trying to help to overcome these problems in engineering education. One of them is the World University Service Austria (WUS), an association committed to the promotion of the human rights in education on the basis of academic freedom and university autonomy. It is organized as a loose federation of more than 40 independent country committees presently chaired by WUS Canada. It has consultative status with the United Nations and the UNESCO. It was established as a non-profit organization in Graz in 1983. Since then WUS Austria has been working towards the promotion of higher education in various countries all over the world. It has set up local offices in five cities in South-Eastern Europe (SEE), in: Belgrade (Serbia), Podgorica (Monte Negro), Sarajevo (Bosnia and Herzegovina), Banja Luka (Bosnia and Herzegovina), and Pristina (Kosovo). There are several successful activities organized by them to help to reconstruct and advance the process of higher education in the SEE region, such as:

- Brain Gain Program: aims at breaking the academic isolation of SEE universities by inviting qualified academics originating from the region to lecture courses which are not available at the SEE universities.

- The Course Development Program for the implementation of new or modified courses with the objective to facilitate the transition of higher education towards Western European standards;

- eLearning Task Force program: aims at breaking the academic isolation of SEE universities by inviting qualified academics originating from the region to lecture courses which are not available at the SEE universities.

The first author worked at the Civil Engineering Faculty in Subotica (GFS), the University of Novi Sad in Serbia for 20 years. She left Yugoslavia in 1995 and since then has been working at the University of Western Australia. Over the last nine years she has gained an insight into the western educational system. As part of the Brain Gain Program she was invited by GFS to come back to the region to teach as a
BRAIN GAIN PROGRAM

The aim of the Brain Gain Program is to provide international scientific exchange and cooperation in order to contribute to the development of universities in SEE. Also, to have a "brain gain-effect" by linking guest lecturers to already existing networks in their home countries and make them a driving force of knowledge transfer and quality assurance in their countries of origin. This aligns very well with Bologna Declaration, the new initiative in Europe, devoted to engineering education to create more uniformity in engineering education, more mobility in the engineering profession throughout Europe and to have a unique European system of engineering accreditation.

It was arranged for the first author to spend three weeks at GFS, introduce a new unit and deliver it using new teaching methods.

INTRODUCTION OF NEW UNIT

The program was undertaken in the winter term 2003. Thirty five 2nd year civil engineering students volunteered to participate in this program. The new unit, Visual Communication, was introduced. The closest existing unit in GFS is Descriptive Geometry. The unit has been around for couple of decades and is still being taught in a very traditional manner using manual drafting techniques with tedious and time-consuming projection techniques to solve design problems. Significant time is devoted to this unit: 45 hours for lectures and 30 hours for tutorials. Assessment is based on weekly tutorials, two partial exams and one heavily weighted final exam. [3] The whole exercise has been very unfriendly and time consuming for students and staff. Similar courses were abolished in most Western engineering schools some time ago, after the introduction of computers in 1970s.

The new unit Visual Communication aimed to establish the transition process from a traditional engineering graphics courses, Descriptive Geometry and Manual Technical Drafting, to an integrated curriculum of visual communications in engineering such as multi-disciplinary collaboration of the whole range of graphical expressions: computer graphics, engineering freehand sketching, technical illustrations, diagrams, poster presentations, photography, web page design and movies. The objectives of such an approach are to prepare students adequately in this area for the contemporary engineering workplace, locally and globally.

Teaching Tools: It was possible to organize a high quality teaching and learning environment during the Program using all necessary multimedia information technology tools because at that time GFS had received 20 brand new computers, projector, video camera and photo camera as the donation from WUS Austria. The only obstacle was the slow Internet connection. The new unit was placed within WebCT but it was not possible to experience all the benefits of using such a Learning Management System because of the long waiting time to open the sites.

Teaching Philosophy: The aim was to present a new unit in an innovative way that was not preoccupied only with the content delivery but more concerned about developing skills and attitudes, and which would emphasize the ability to utilize knowledge rather than just acquiring knowledge, to demonstrate the ability to identify and solve problem and to ensure deeper learning. Expected outcomes were to:

- Indicate directions and incentives for the improvement of broad range of professional skills and abilities necessary for the contemporary global engineering market, such as: the ability to communicate effectively in visual, oral and written ways, the ability to solve engineering problems, the ability to work in teams, and the ability to learn independently and develop life long learning skills.
- Test the possibility of delivering teaching and learning in English and establish the habit of using international teaching and learning resources such as online resources, international journals, books and making links with international universities.

The course comprised 15 hrs of lectures and 45 hrs of tutorials. For the first time in this school lectures and tutorials were delivered in English. The official language in the school is Serbian with the possibility of completing quite a number of units in Hungarian because of the large number of students and staff using this as their first language. The reason for this is the geographical proximity to Hungary. The use of foreign languages is quite common in this part of the world. Students responded very well to the use of English.

Lectures: There are two major educational challenges for a lecturer teaching a large group of students: student feels anonymous and passive. To break this isolation, lectures were organized in a discussion mode. Lecturer told a short story about herself and about the organization of higher education in Australia, educational principles, teaching philosophy and methods of assessment in that country. Students were informed about what Industry around the world expects of them. After that students were asked to introduce themselves to colleagues next to them. The scope of the course was identified and the ground rules were set up. It was observed that students were very quite at the beginning when being compared to their Australian counterparts. It was obvious that they were not used to participating during lectures. Eventually, they felt much freer to interact.

The aim of lectures was not to deliver content knowledge which could already be accessed on the Internet but rather to discuss the topics, to provide instructions, co-ordination and support for students to organize their own learning process in their own time and at their own pace using suggested resources of information and conducting their own research. Students were encouraged to use many different sources of information and not relay only on one prescribed textbook.

Various learning activities were organized to reach defined outcomes: freehand drawing tutorials, computer graphics sessions, team projects and oral presentation.

The essence of the teaching philosophy was a student centered approach; to move the learning process from the lecturer to the student.

Tutorials: Comprised freehand drawing sessions, computer graphics labs and team projects.

Freehand Drawing Sessions: students learned fast sketching techniques using markers, as well as other sketching
techniques, one of the most important skills which they will use as future engineers. International companies do not pay engineers to do drafting and produce final drawings, as it is very often the case in SEE. Engineers are expected only to sketch while designing, at meetings or on site while giving instructions. That is why it is important for students to learn to use graphs, charts and illustrations as a tool to convey fast, ideas and messages in engineering profession.

**Computer Graphics:** Students were involved in different activities to learn how to use AutoCAD software for producing 2D (two dimensional) and 3D (three dimensional) images. The expected outcomes in this area were a basic knowledge of this software in order to understand its capabilities and to be able to give instructions to their draft-persons.

Part of the learning technology literacy was web page design using Dreamweaver, so students were able to submit their projects in web format and to put them on the Internet, thus making them available to other students and the wider community. Photoshop was used for manipulation of images.

**Team Project:** Engineering schools around the world are introducing more and more project based learning in the curriculum. These projects are very often linked to Industry needs. It is especially the case with the final year projects – diploma work.

In this program students were asked to work in seven teams of five people each. The topic of the project was “Visual Diary of…………….”, of seven most remarkable buildings in the city. The Diary had to comprise freehand sketches, relevant information on short history and structural system of the buildings, using graphs, charts and illustrations, AutoCAD drawings, digital photos and movies. The expected outcomes were to enable students to provide good visual information on an engineering project; to give poster presentations using different kind of visual tools and to work in teams.

Students were acquainted with the importance of learning how to work in teams because in the engineering profession almost all work is done in teams. The main features of working in teams were presented and it was suggested to them to create teams in accordance with appropriate skills of each member.

These projects were meant to incorporate all knowledge and skills that they acquired during the course. Project results, the joint effort of the whole team, and contributions each student made to the team were major bases of assessment.

**Poster presentation:** At the end of the project each team had to give an oral presentation on their project in front of their colleagues and staff. Students felt a little uncomfortable with the idea because they had never done this before. However, surprisingly all went remarkable well. They used posters as a tool for presentations as well as Power Point. It was a pleasant event with light refreshment at the end to celebrate the results of the projects.

**ACQUIRED OUTCOMES**

At the end of the Program projects were assessed in three different ways: staff assessment, peer assessment and self-assessment. The best projects won awards but also each course attendee received a totem for participating. The best seven students were trained additionally to become demonstrators in the related disciplines.

The program and the way the teaching and learning was organized was an experience for students, they stated in their evaluation form (Figure 1). They expressed great interest in what their colleagues around the world are doing and the way they have been taught and how their learning process is coordinated. They responded very well to each task. They attended sessions regularly, were active during the course and the projects they produced were of very high quality, of similar standards to their counterparts in Australia in similar projects. They showed that they can respond adequately to versatile teaching and learning techniques. They are enthusiastic about using the latest technology once it is accessible, and they can communicate efficiently and effectively in visual, oral and written forms. Also, they can work independently and in teams if the teaching and learning process is organized in this new way. What students learn and how they learn depends entirely on the staff teaching methods.

The use of English had also very positive outcomes. It is time for this Faculty to start to deliver some lectures in English and make Faculty closer to international events.

**DISCUSSION**

Engineering education around the world has been changing rapidly in the last decade. Isolation and the constant lack of funds in this region cut students and staff from the full information on world trends in teaching engineers and the future of the engineering profession.

It was noticed that GFS students showed remarkable content knowledge in all areas of engineering. It is obvious that they have spent significant amounts of time learning an enormous amount of information to try to pass exams, sometimes even ten times. But when asked to investigate and solve new problems it was observed that they lack research skills and skills to work independently using multiple sources of information. In Bloom’s taxonomy of knowledge and understanding, these are only the first two steps in the learning experience. Significant changes should be considered to enrich the education of engineering graduates in these universities to transform an existing, conventional curriculum into one which will provide active learning, open ended sessions and provide movement towards the next levels of Bloom’s taxonomy pyramid: application, analysis, synthesis and evaluation of learned material. [4]

Engineering Accreditation Boards around the world are proclaiming that emphasis should be on the development of professional skills if we want to achieve interdisciplinary learning in students. In industry practising engineers must be able to unite technical ideas in one area with technical ideas in another and with economic, environmental, social and ethical problems. An integrated learning approach is the future of engineering education.[5]

Active learning techniques such as project-based learning and team work are the best way to develop professional skills and all leading engineering schools are applying these methods more and more. Let students learn from experience rather than just from passive lectures and from one textbook written from the course lecturer. Make the whole term active and constantly monitor and evaluate students learning results rather than just
relay on final exam at the end of term. Move the learning process from lecturer to students.

CONCLUSION

It is obvious that universities in this region lack funding and freedom to implement new initiatives. It is also hard to break conventional approaches and established procedures, inflexible linkages, highly independent academic units, and staff who are schooled in an expository teaching style. It is wide spread opinion in this region that any reduction in content will weaken educational results. Understanding the theory is important, but in practice it is essential to be able to apply that knowledge to the real problems. Engineering education is alive and anticipates constant experimentation, innovation, and improvement. It is a big challenge to make a change in this situation but there are ways to do it in spite of the constraints such as to:

- Use WUS Austria and similar resources,
- Take active role in Bologna Declaration,
- Provide permanent staff development training in teaching and learning centres,
- Encourage teaching and learning research,
- Use global information system, attend international conferences on engineering education and talk to academics from different parts of the world, establish contacts, cooperation,
- Link to international journals on engineering education and read what is available online,
- Visit leading universities.

The Brain Gain Program is a great opportunity to make a step forward in this endeavour. Thanks to WUS Austria for this opportunity to attempt to push traditional engineering education in this part of the world towards the global trends and as the result of its success the cooperation will continue in 2004.

![Program evaluation from 33 students out of 35](Figure 1: Program evaluation from 33 students out of 35)

**REFERENCES**


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