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Integrated Project System and Supervised Industrial Placement – Essential Cores of Civil Engineering Education

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Abstract: Since the early nineties the Civil Engineering Faculty of the Silesian University of Technology in Gliwice, Poland has been involved in 3 Tempus projects, aimed at modernising the Faculty educational system and its adjustment to European Union standards. The first and second projects were directed at creating new specialities: City Regeneration and Constructing Architect, both in the Faculty College in Rybnik. The experience of these two projects formed the basis for the third Tempus project, entitled BestSys, which is aimed at total modernisation of the Faculty educational system.

A few years work on the educational system in co-operation with European Union partner Universities has resulted in a comprehensive review of Civil and Structural Engineering Education. Two elements have been recognised as being particularly important for effective teaching in this area and probably in all technical studies. These are the Integrated Project System and a Supervised Industrial Practical Placement.

The project classes should be focused on the comprehensive solution of two to four integrated projects, scheduled for all study periods, instead of tens of independent project exercises in particular subjects. The syllabuses of lectures and all teaching hours should be constructed to provide not only general knowledge in particular subjects but also all information necessary to solve the actual project tasks.

The system was successfully tested in the faculty educational practice. Experience has proved that:

- students are interested in the complex solving of the whole of an initially simple problem, rather than in more complex professional tasks,
- students are aware of the usefulness of knowledge taught during lectures.

This results in improved assimilation of knowledge, in practical training in basic professional skills and finally in improvement of the efficiency of studies.

The second important factor in effective education is the practical industrial work experience. In technical sciences a continuous interchange of information between education, research and practice is a prerequisite of progress. It is also an essential precondition of effective teaching in this area. In new curricula developed within the Tempus BestSys project a Supervised Industrial Practical Placement was introduced during the 7th semester at the 1st undergraduate level of studies.

Keywords: two-stage studies, civil engineering, problem-oriented education, industrial practical placement

1. Introduction

The problem of how we should teach and what students should learn always was, still is and will continue to be discussed. It probably cannot be solved definitely once and for ever, as new times usually need new solutions. However we should always keep in mind some basic rules referring to university education. These are:

1. Education doesn't mean teaching, but rather forming an attitude which remains even when one has forgotten everything one has ever been taught.

2. The appropriate balance between "know how" and "know why" is crucial for technical university education. A university is not a professional school and should never abandon forming the creative attitude.

While talking about technical education we must keep in mind that a continuous information interchange between education, research and practice is a prerequisite of progress. It is also an essential precondition of effective education in this area (Figure.1).

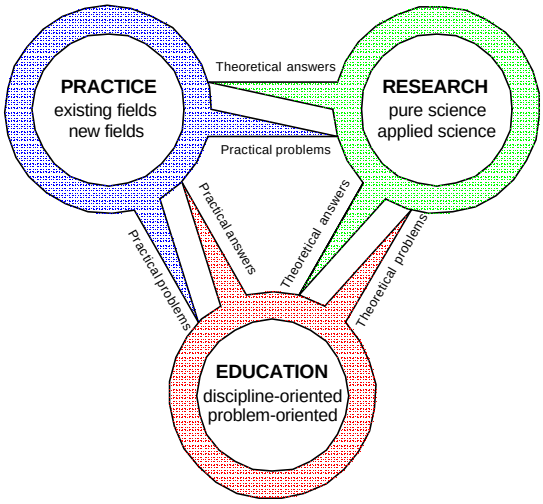

Figure 1. Scheme of information interchange in technical sciences [1]

To ensure the appropriate research impact for education the university cannot be only the higher education institution but must also be what the term "university" really incorporates. In this paper we will concentrate our attention on the means which assure the information interchange between education and civil engineering practice. The experience gained during the restructuring of the educational system at the Civil Engineering Faculty of the Silesian University of Technology in Gliwice, Poland forms the basis for our opinions.

2. Some remarks on the hitherto existing educational system in Poland

Traditionally higher education in Poland was, and still is, oriented towards Master degree courses. The opinion still predominates in Polish mentality that only a Master's degree means really high level education and the Bachelor degree is a kind of substitute. This approach affects the educational system: every academic school should offer a 5-years full-time MSc course. Industry requirements forced the introduction of 4-years BSc part-time and full-time courses, but these were always considered as a worse branch of studies. Practically all technical universities in Poland previously accepted, and many of them still accept, such a model. A similar situation existed at the Faculty of Civil Engineering of the Silesian University of Technology. Our educational system was based on a number of completely independent full-time and part-time MSc, BSc and PhD courses.

The educational system existing in the early nineties was the result of several different factors, not necessarily depending on an aspiration to improve the quality of studies. Among these factors we should mention:

- the characteristic of the previous political system to treat higher education as a continuation of school teaching rather than university studying,
- popular opinion that the importance of a subject, and of a professor responsible for it, is directly dependant on the number of teaching hours,
- a strongly specialisation-directed model of education,
- the total neglect of inter-university student exchange requirements, particularly with respect to EU countries.

The previous system became extremely ineffective for the following reasons:

- the huge number of courses with practically independent curricula and programmes for each speciality resulted in similar or even the same subject contents being taught several times for small groups of students.
- the huge number of subjects (more than 40) caused the education to become subject not problem oriented. Instead of solving problems students are learning particular subjects. Only a few of them are able to join the separate information included in particular subjects into the integral knowledge necessary for creative professional work.

- the huge number of teaching hours (usually about 30 per week) makes students fight, rather hopelessly, to pass all subjects rather than study.

The previous system in practice hindered international student exchanges, not only due to curricula and programme differences but also due to a system of crediting that was completely incompatible with European standards.

To conclude this rather pessimistic appraisal let us emphasise that, in spite of the various drawbacks of our system, the education results still remain surprisingly positive. Graduates of the CE Faculty of SUT are always well approved by the industry not only in Poland but also abroad. This proves an old rule, that in education much more depends on master's knowledge, pupil's talent and their common engagement than on any external conditions. It doesn't mean, however, that these results couldn't be better with a more effective system. Considering mainly the total incompatibility of our model with those in EU Universities, resulting in difficulties with participation in international student and staff exchange programmes, we decided to modernise our educational system. This was undertaken within the Tempus project called BestSys and opened a great chance to think over all the problems connected with education, thus creating something really good for the beginning of the new millennium.

3. BestSys – objectives and participants

The Tempus project entitled "Two Stage **B**uilding and Civil **E**ngineering **St**udies **Sys**tem" (acronym BestSys) was started at the Civil Engineering Faculty of the Silesian University of Technology in December 1997 and is scheduled for 3 years. The main objective was defined as "Restructuring of existing 5 year MSc courses into 2-stage BSc+MSc system and adaptation of curricula to EU standards". Two of the ten partial outcomes are aimed at creating a problem-oriented approach in education and its links with engineering practice. These are:

- Elaboration of an integrated project system for new curricula.
- Definition of Supervised Work Experience basic rules.

The project is realised in co-operation with 6 EU Universities. These are:

- University of Bradford, University of Loughborough and University of Glamorgan from UK,
- University of Beira Interior from Covilha, Portugal,
- Politecnico di Torino from Italy,
- Horsens Polytechnic from Denmark.

From the very beginning the modernisation was directed towards a two-stage model which should create, together with the existing PhD course, a consistent and effective educational system.

Two main advantages of such a ladder system are:

- A natural process of revealing the best students for higher levels of education,
- The possibility, or even necessity, of a logical partitioning of the full knowledge taught within each module and subject between BSc, MSc and PhD levels.

4. Implementation of integrated project system and supervised industrial placement into faculty practice

While planning the curricula and syllabuses for two-stage studies we always kept in mind that we should provide basic professional skills for all graduates, especially those who finish their education at BSc level. We should also prepare all students for independent and creative thinking as well as for the forthcoming need of self-education. This can be achieved by stimulating independent study and limiting the traditional school teaching. The motto: "Stop teaching, start learning" was strongly emphasised.

Educational training should be problem oriented. We should solve problems instead of teaching subjects. A problem-oriented approach in education and its links with engineering practice are achieved due to an Integrated Projects System (IPS) and a Supervised Industrial Practical Placement (SIPP).

Integrated projects are the basis of practical education training at the engineer's level. The widest possible scope of project work should be available for such projects. This will decrease the total number of projects developed within particular subjects not related to each other and concerning only particular tasks within particular subjects. An integrated project will allow for comprehensive and alternative solution of the problem. Teams of 2~3 students on the project are recommended - this would teach students team work and give them a chance to compare a few alternative solutions of particular project problems.

During the 7th semester students are obliged to undertake practical placement at enterprises with which the Faculty will sign an appropriate agreement. Such a placement will be supervised by Faculty staff members. The placement, lasting three months, takes the shape of three basic forms:

- individual placements in industry,
- group placements in local administrations and authorities,
- training abroad, mainly in Denmark.

Both solutions (IPS and SIPP) were first implemented in the Rybnik Faculty Branch, with great success. The study curricula were established on the following model:

- six semesters of studying,
- the seventh semester a Supervised Industrial Placement,
- lastly, the eighth semester for an independently performed Final Project.

In spite of many doubts, particularly over the form of the training and industrial placement, just putting it into practice brought particular success. Independent students aiming at widening their knowledge and further professional career are more and more willing to look for this kind of contact. We can say the same about the Employers – they are keen to look for the best employees. We are glad to find this proved each year when Employers, invited for the public presentation of Final Industrial Placement Reports, express their positive opinion about the students, stating their willingness to employ them after graduation.

The public presentation of the full semester design work, together with the SIPP Final Report and the exhibitions of training organised by local authorities and the Faculty, are significant factors enhancing a student's self-motivation. The positive impact of this form of training can be clearly observed in students' approach to work and studies. They obviously become more mature, starting to appreciate the work of others as well as themselves. Their projects and presentation are more creative and realistic, paying attention to the technical detailing. It should be emphasised also that the form of the projects improves and becomes professional.

Integrated projects as well as the Industrial Placement hone the student, preparing him or her not just for a Final Project but also for professional life.

Due to the obvious success of the experiment at the College Faculty in Rybnik, showing the advantages of the Integrated Project System and Supervised Industrial Placement over the existing training system, the Civil Engineering Faculty decided to implement the placement on a general scale. The Tempus project BestSys started just when the positive results of the Rybnik experiment had been observed. BestSys in its foundation was meant to restructure the main stream of civil engineering education in the Gliwice curricula, and their contents, with orientation towards the Integrated Project System and Supervised Industrial Practical Placement.

The syllabuses of the curricula were prepared with the help of the EU partners involved in BestSys, who shared their knowledge and experiences, advising, consulting and being open for visiting and to be observed. The curricula were finally accepted two years ago, to be implemented in the academic year 1998/1999 with the first group of 135 students to pass the entrance exam to the Civil Engineering department. The program has been started, and teachers and students have already been following the synopsis for four semesters. In the academic year 2000/2001 300 students will be enrolled for the first year of studies in the new system. The general scheme of this system is presented in figure 2.

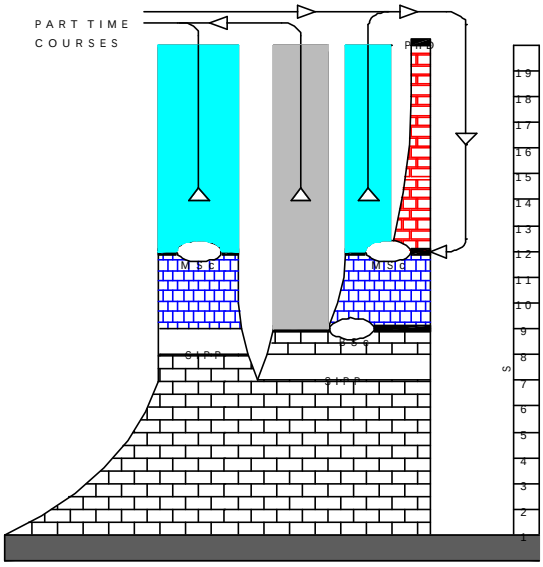

Figure 2. Scheme of the educational system at CE Faculty of SUT

During the first six semesters of studying two or three (depending on the speciality) integrated projects are developed. In study curricula there are 6-7 hours per week (one day) provided for the integrated project. The first project is relatively simple (an individual house) and its main objective is to introduce students to the design work. Subsequent projects deal with more complicated design tasks. Students' work is supervised by teachers representing different subjects, according to the plan adjusted to current design progress. At the end of the semester, during the final presentation, students are assessed by all teachers involved in the project.

Again some anxiety and doubts appeared connected with the organisation of industrial placements for a large group of students, four times more than those which had previously occurred in Rybnik. It was easy to place SIPP into the curricula, and it was also easy to prepare the scheme of its framework. It was established that every student should take part in SIPP and now the job has to be accomplished. The practical training should take place during the seventh semester of the bachelor course, and according to University Statute cannot last longer then 15 weeks. The prepared statute of SIPP divides rights and duties into three basic groups concerning students, university and employers. The rules of SIPP were established with the active assistance of partner EU universities, so they are similar to those already existing and being checked in a real-life solution in Great Britain or Denmark. Hopefully, this scheme can be adopted on Polish ground, bringing the expected positive changes. A stress-relieving feature may be the information that Polish Employers have positively linked with the scheme, ensuring Faculty places for all 90 of the students planned for next year.

The training within SIPP will be rewarded with special written certification signed by the employer's chartered engineer. According to the state regulations this certificate will be acknowledged later on when the graduate strives for the position of chartered engineer.

5. Conclusions

The effective solution of a Supervised Industrial Practical Placement, observed in Denmark and the UK, has highlighted the necessity of changes in the rapidly ageing Polish Civil Engineering professional education. The first project implemented in Rybnik turned out very fruitfully – students' interest in solid work and their self-motivation has grown significantly. Encouraged by positive examples of British, Danish and now also Polish practice, the Civil Engineering Faculty at Gliwice decided to make another step forward by implementing IPS and SIPP with a comprehensive integrated project in the framework of two-stage studies. The response of Industry seems to be promising and so hopefully next year we will have the pleasure of presenting successful results.

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