
VIRTUAL PRACTICAL TRAINING IN ENGINEERING FIELDS

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Introduction

Engineering education is a field of higher education that requires a broad range of practical skills to be offered to the students (Litzinger et al., 2011). The university curricula always involve some periods of work placements in companies, in order to allow students to get the real work experience in fields where they might practice after graduation. Many times, the physical realisation of such work placements is quite difficult due to different factors: mismatch between the schedule of the work placements in the university curricula and the companies' availability, lack of possibility to host many students (especially at the beginning of their student live – characterised by a lack of basic knowledge), lack of supervision personnel inside companies etc.

It is recognized both by the academics and the industry that there is often a disconnection between the theory learned in the university regarding the discipline area and the practical skills expected by companies at the start of an engineer's working career (Barber et al., 2013). Many times, companies have to invest in providing an extra training, immediately after hiring a young graduate.

It has been argued (Dalgarno et al., 2014) that the disconnection between the theory and the practical skills creates some fundamental difficulties: students have an incomplete knowledge of the practice context; in their university-based learning, students are asked to apply the theoretical ideas they studied to contrived or inauthentic problems; when students engage to professional practice, the messages provided by their supervisors may be different from those received from their university lecturers.

One possible solution to the raised problems is to involve students into university – enterprise cooperation (Ugwuanyi & Ezema, 2010), as soon as possible in their academic training, through different forms of work placements (Vriens et al., 2011), including blended and virtual ones. Usually, the term of virtual placement or virtual mobility is viewed as a form of learning which consists of virtual components facilitated through an ICT supported learning environment (Grove, 2008), where the three key stakeholders (students, universities and enterprises) interact with one another independent of time and space (Rintala & Schrader, 2010).

Background of the research

Politehnica University of Timisoara has a recognized history of cooperation with the economical area. This cooperation mainly embraces research and technological development, where students are many times actively involved together with the academics. The weak point is that this sort of cooperation mainly involves the top students, which will probably embrace a research or academic career after graduation. Still remains the problem of the average student, which will typically embrace an industry career – usually without a strong practical experience and without the practical skills expected by the employer.

On the other hand, the University has a strong expertise in providing blended and online learning and training, through its Center for eLearning, by using its own ICT platform. This centre also developed the university Virtual Campus, which can be used in order to facilitate online cooperation in training with industrial and academic partners from Romania and from abroad.

Based on those key factors, the university started a project for providing its students with practical training in real working conditions, in cooperation with the main economical actors in the region. The project has been implemented at national level, in order to test the possible cooperation between actors in different regions in the field of technological practical training and to see whether there are substantial cultural differences between those regions in the field of training and enterprise culture.

Research project's goals

Simulated enterprise for technical work in technology companies is a European Social Fund project implemented by the Ministry of Education, in partnership with Politehnica University of Bucharest, Politehnica University of Timisoara, Constantin Brancusi University of Targu-Jiu, conducted between 2011 and 2013. The project aimed mainly at increasing the employability of university graduates in terms of training and development of the engineering practical skills required by employers, by developing and implementing an integrated information platform that simulates the real working technology companies and hiring specialists from these companies for students' practical training and for developing supporting materials. These goals were accomplished by using an innovative tool for Romanian higher education: simulated enterprise.

To implement the simulated enterprises it was established one laboratory in each partner University and tutors from the private sector were used to prepare students for the labour market through training, simulations and applied exercises. Subsequently, 240 students with outstanding results from a total of 600 learners benefited of internships in companies that provided the initial tutors.

The project aimed to recruit twenty-four tutors from the technology companies involved. The immediate benefits for the companies were:

- access to future graduates with specific training through customized applications,
- promoting the reputation of the company in the academic field,
- increase the degree of employee's satisfaction by harnessing their potential as tutors in the project,
- increasing the company's reputation.

Concerned by the formation of engineers that will demonstrate not only a solid base of knowledge but also real practical skills specific for any engineering graduate, Politehnica University of Timisoara had the role of regional partner representing the urban growth pole from the western area of Romania.

At the Politehnica University Timisoara, the project was coordinated and managed by the Center for eLearning, with the support of the Faculty of Automation and Computers and the Faculty of Electronics and Telecommunications and with the involvement of 8 specialists from companies attracted in this project. The training provided was designed for a total of 200 students from the faculties mentioned above and were mainly focused on:

- Practical activities of virtual project management;
- Software virtualization solutions;
- Simulation of the technological flow specific to the IT companies / telecom;
- Teamwork activities;
- Professional communication specific to engineering field (communication techniques, professional interaction).

The project was not designed just to meet a need felt by universities (a better insertion on the labour market for engineering graduates) or a need of senior students (to work immediately after graduating), but wanted to come half way to meet with current problems of recruiting young workforce, problems that technical companies are facing with.

From the employer's perspective, the project is an opportunity to:

- Influence, adapt and customize students' training content based on practical needs of the company, so that the graduates will be operational employees in a very short time and with minimum costs of initial training;
- Select and recruit students really passionate about the study, with outstanding academic achievement and training potential after graduating;
- Train the tutors, motivate and reward specialists from companies, people responsible with the initial training of the entry-level employees;
- Strengthen and make visible the reputation of every involved company and then the company's involvement in projects with direct social impact.

Project implementation

Conducting simulated enterprise laboratory consisted in activities (including teaching – learning – assessment) supported by tutors recruited from the technology companies, to develop competencies among students that were following technical studies in four key areas of study: computer science, computer and information technology, electronic engineering and telecommunications, systems engineering.

The software component consisted in a number of IT solutions implemented in carrying out teaching – learning – assessment activities as:

- Portal information solution through which students, teachers and tutors communicated and collaborated during the simulated company laboratory and through which the project results and information were disseminated;
- Document Management Solution - to manage the necessary resources in teaching and learning;
- Students–teachers-tutors relationships management system;
- Computer system for simulation of case studies and practical simulations in virtual environment - students played different roles within this solution in business processes specific to technology companies;
- Assessment of acquired competences solution – was used mainly in assessing students' knowledge.

During the simulated enterprise laboratory organized at UPT numerous actions with advantages in training engineering students in line with the current needs of active employers in national and international labour market were facilitated.

The main activities were:

- Accurate simulation of real engineers working environment in a workspace where students were virtually exposed to various professional tasks and took appropriate professional behaviours, interacted easily with technical experts and teachers from partner companies and practice coordinators from the Politehnica University of Timisoara;
- Training a large number of students (200 students in Computer Science, Systems Engineering, Telecommunication Systems' Technology, Applied Electronics - second year of study) and the involvement as tutors of 8 technical experts from leading employers in the western area of Romania (OCE Canon, Continental Automotive Romania, HELLA, Flextronics Romania, ETA2U, Lasting Systems, Expert Consulting, MMD Design);
- Case studies and professional training courses provided by technical experts from partner companies, covering three important levels of engineering training (technical knowledge, business/entrepreneurial knowledge (project management, financial management etc.), professional communication skills (verbal and written interaction - company specific), in order to make students operational in a short time and without

extra charge for the employer (case studies examples: Redundant systems using virtualization technologies for infrastructure server (ETA2U), Server Monitoring on Mobile (OCE Canon), Internal audit management system in an organization from the automotive field (Continental), Tendering process / contract to carry out a Data Center (Lasting Systems));

- Sharing resources, information and professional experiences as well as their use in training future generations of students by the main actors involved in the practical training of students (partner universities, students, teachers, employers);
- Equipment and educational software developed and integrated in the online virtual environment.

The project has developed a methodology for conducting internship and student assessment that included instructional working methods, curricula for 90 hours, the assessment module and innovative use of ICT in the concept of virtual practice.

Practical placement is an academic compulsory activity that usually last 3 weeks in the summer, at the end of each academic year. This project extends this period over an academic semester, starting with February, with virtual activities, face-to-face meetings between students and their tutors from companies, constant communication and, at the end, a period of 1 week within the company.

Practical activity started with tutorials for tutors from the university, for students, tutors from companies on how to use the portal built for this purpose. The next step: students were distributed to companies, generally according to their options. Tutors from companies presented to students 2, 3, 5 or 8 themes, forming work teams associated with each theme.

The work methods, although the themes were different in type, have been somehow similar:

- Face to face presentations, explanations, questions;
- Homework, with results sent through the portal and discussed while direct meetings;
- Closure project, PowerPoint presentations and multiple choice test for evaluation;
- Visit and practice in enterprises close to the university and within the country.

A group of students with the best results followed a rigorous internship program in two representative companies that each partner involved in this project proposed: HELLA, Continental (Timisoara), Grimex, Inidan (Targu-Jiu), RoStar, AMRO Q Quadrant Beverages – Pepsico (Bucharest), and finally participated at the national seminar held at the Politehnica University of Bucharest, at the end of the entire process.

Project evaluation

The evaluation of the project *Simulated enterprise for work techniques in technology companies* has been done both from the point of view of students and of the companies.

Evaluation from the point of view of students

Tutors from the Politehnica University of Timisoara had discussions with the participating students, of which may be summarized as it follows:

- IS methodology was advantageous because it freed student summer holidays;
- Students' contact with people from companies created a clearer picture of how to work in a company;
- The suggested topics were related to real problems treated by employees of the company, so the information the students received came on the shortest path and it was very clear;
- Issues and documentation were clear and seriously presented, according to the standards of a company;
- All these issues have been a challenge for students and forced them to take the activity seriously;
- There have been students who have signed employment contracts for short and medium term with certain companies.

Evaluation from the point of view of companies

For companies, according to the tutors opinion the activity was a success for the following reasons:

- They had the opportunity to present the company to large groups of students (about 25 each);
- Strengthened cooperation with Politehnica University of Timisoara. All companies involved have a long history of cooperation with the University, and this activity came to support this collaboration;
- Students' problems became known and after participating at professional and organizational development it was possible to find the right students to employ.

Focus group results

The results of the discussions in the focus group are summarized in Table 1.

Table 1 Focus groups results before 6 pts, after 3 pts, left aligned

Advantages	Drawbacks
Gaining confidence from the technological environment and from the economic environment in relation with universities / higher education	Highly professional trained tutors, but with minuses in transmitting information towards a group of students
The involvement of powerful multinational	
Teamwork – mix of students from different specializations, a plus for job interviews	Poor access to the platform
Encouraging the idea of “blended learning” – a mix between face to face meetings and remote access	
Extracurricular training	Improved Platform for specific applications
Employment opportunities – professional horizons were stretched	
Eliminate time spent/lost with public transportation towards the company, especially towards those located in the outskirts of the city	Infrastructure – computers, projector – purchased tardily
Using a qualified staff in companies while exposing technological processes	
Practice made during the semester in parallel with the actual teaching	Projects irrelevant to the company, in some cases
Determining priorities for professional development	
Information on internal procedures	

Testimonials from the companies

“The tasks and objectives have been met almost entirely with small exceptions regarding presentations and supporting them: Some pages were overloaded with text and others were too expedited. Presentation in front of an auditory revealed a certain timidity of some students and superficial trends for others.”

“Following the visit, the presentations from previous meetings and individual study found that most students were accustomed to the terminology and specific processes of production of electronic modules.”

“All participants have proven that they can perform tasks and can absorb in a short time the necessary knowledge. Attitude has been positive – being impressed with the way of working in a company/in a project – which is different than in college.”

Testimonials from the university tutors

“Students initially looked with disbelief at the simulated enterprise, but at the end of the activities they have perceived it as an effective activity that brought them a real gain both professionally and in terms of organizational, managerial, etc.”

“Students have taken seriously the themes offered by companies and have been seriously involved in solving them.”

“There was very good communication between the permanent tutors of the company and the University. There were no interruptions or incidents at any level.”

“Students have used the portal IS taking contact with such an application, necessary for some future activities.”

Conclusions

According to the project evaluation, done from the perspective of all involved actors (companies, university, students) the results proved to be positive. The companies were particularly happy that they were able to provide specific training for the students from the first year of study, and to accommodate students with the real working mentality about deadlines, internal communication, discipline, etc. The following year, many of the students participating in the project were accepted by the companies for internships and for taking part to joint project research. It is expected by the companies to cut-down the cost of training for their future young employees that should be better prepared for their working career. The university was happy to be able to provide a better practical training and to take advantage of the mentality change for some of the students that proved to become better motivated for studying and building their future careers.

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