HYCE – Hyperlearning in Civil Engineering Curricula

A Pilot Course in Implementation of Information Technology Course - a Case Study at the Faculty of Civil Engineering, University of Zagreb

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Abstract: Outline of development of a revised base ITC course at the Faculty is shown here. The course, called Introduction To Information Technology Implementation is aimed for 2nd year students (3rd semester) of the study. For the first time it was held in the winter semester of 2002/03 as a pilot course replacing the old way of course delivery. This implementation was carried out through a "pathfinder" project WORMES from February 2002 till March 2003 and would be used as a template for future Hyperlearning implementation on other courses through other Faculty education programes.

The objective was to establish continuous students teamwork around a problem – a project completely accomplished in IT surround. A slightly adapted methodology known as Hyperlearning – a version of Problem Based Learning, was chosen as a based learning methodology for a new way of course delivery.

The gained results were really impressive. Not only efficiency of delivery was increased in many ways (less hours spent on exercises, better knowledge detaining...) but also huge enthusiasm among students was constantly maintained and their creativity was emphasized surprisingly. A lot of data were collected, analyzed and some of the results are published here.

Keywords. Hyperlearning, Problem based learning, IT course development

Current problem in the project area

Over the last 15 years, for well-known reasons, the curriculum development at our Faculty remained at the level of late 80's, when it had an established reputation and was widely respected for the quality of its graduates in civil engineering. Consequently, as the Faculty staff largely missed out on the IT intensive development time of the 90's and its application to changes in the delivery of teaching, we currently face not only a diminished interest of potential students (as a more general problem), but also a problem of the new generations of students which have been profoundly influenced by IT. We strongly believe that the availability of IT and Internet in particular for these new generations have a decisive influence on their perception, on their sub cultural behavior, which is reflected in finding the traditional teaching methods not interesting enough.

The proposed methodology "HYCE – Hyperlearning in Civil Engineering Curriculum" will enable University of Zagreb, Faculty of Civil Engineering to achieve comparability with the European educational standards and give both teachers and students the possibility of "e-mobility" through European universities, particularly considering inter-university co-operation for the introduction of a European dimension.

The Hyperlearning model, chosen as a base delivery methodology, provides students greater knowledge and skills than the conventional lecture/lab approach. It teaches students to work effectively in teams - the #1 requested skill of employers, effectively addresses individual student differences and different learning styles, provides students greater knowledge and skills in less time, dramatically improves students' ability to retain information over time, improves student retention through development of social ties and teaming, helps students to mature and become self-reliant, and teaches students how to learn and how to teach as well. It represents a synthesis of current best practices and approaches in civil engineering and combines five methods: 1) Lecture; 2) Tutorial Teaching (instructor-facilitated) used to teach (computer-based) skills; 3) Tutorial Teaching (self-directed) on a computer workstation - an essential skill for students to possess in order to succeed long-term in a rapidly changing information society; 4) Group Recollection - students collaborate and work in teams to create, solve problems, and complete projects; 5) Student Teach-back portions of the curriculum to fellow students . "The worst way to learn anything is to be taught. The best way to learn anything is to teach (Dr. Russell L. Ackoff)."

Scope of the project

Project WORMES was setup with main objective to make all of this running on. It started in February of 2002 and finished in March of 2003 by conclusion of evaluation phase of the new course. The project team consisted of 6 senior students and 2 teachers. This students were not only the force who carried out the most of physic work – creating web content, testing the learning components, but also acted as a creative force since their opinions about way of delivery on this course had been taken into account in a such scale that all of them have been standing as authors of this "faculty experiment".

The old 3rd semester course, called simple "Computers", consisted of series of training workshops for the use of most popular software (MS Windows; Word, Excel, AutoCAD and Mathematica) held in 45 hours for 180 students.

Most complains had come out from students addressing poor achieved knowledge, simmilar to the teachers of successor semesters. Feedback from market was bad as much as it could been – our graduated students, in average, had been coming out of study with insufficient IT knowledge so employers had to spend more time and money to start them into a business.

As the Architectural Constructions is the only "engineering" course in precedent semester a set of last year student works (hand made construction drawings of a simple family house) has been picked up and put into a role of program task to teams. Processing complete construction documentation in IT surround was their project in our new Problem Based Learning (PBL) organized course.

Project rollout

The course was renamed to more appropriate term: Introduction To Information Technology Implementation (ITITI). Because some basic skills

was required for accessing the exercises, a pilot survey had been carried out among this students y aear before. The aim was to getting out a picture of their PC use maturity. The obtained results (75% familiar with MS Word, 38% with MS Excel, 31% with AutoCAD) pointed out a need for additional Word, Excel and AutoCAD trainings that had been held in weeks before official start of course, out of teaching hours. These trainings were not obligatory, but testing was, in accordance to Faculty teaching board recommendation. For this purpose, the web test was designed – the very first of this kind at the Faculty. It demonstrated significant efficiency against traditional way of examination where such examine for 185 students could need relatively strong demand for resources (teaching staff and examine duration). Furthermore, this method expressed itself as a useful self-learning tool. Many students seized an opportunity to find out an answer to a particular question using all available resources, often reached in several mouse clicks.

Original 45 hours fund has been rebalanced to 15 hours of lectures (some of them, in a spirit of IT, was held by video conference link) and 30 hours of laboratory exercises – tutor driven, self – driven and group recollection – in accordance to Hyperlearning model. Extensive teaching material has been offered on the web. By involving of Problem Based Learning students ought to be self - organized in teams, using application forms and procedures posted on the Extranet.

Contribution to Hyperlearning model appeared to be adding on the tutor mid-layer of 5 senior students who acted as team tutors and coordinators (every senior student was responsible for 7 teams e.g. 35 students). As the post-classes survey showed, this was a critical link with layer of senior teaching staff ensuring efficient knowledge flow: Professor – Assistant – Senior students (tutors) – Team Leaders – Active team members – Passive team members.

A team program

A team program was to make architectural drawings detailed for Issued for construction (IFC) level, to extract Bill of quantities (BOQ) out of 3D model, which was decomposed into elements, all of them to be checked to satisfy proper thermal characteristics. As a final result, every team published their own documentation and model to a project web site, which was a part of final presentation. Other parts of presentations were other student's results and experiences, estimate of their efforts per task, ways of team member cooperation, opinions and suggestions. This gave opportunity to students to express creativity, which many of them actually did. Because of extensive mentoring and therefore continue monitoring this aspects of students work influenced their final marks assigned right after presentations. There was no need for post-classes examine and students got more time for other obligations.

A team program was broken down into phases: 1) 3D modeling with ADT; and Thermal calculations with sponsor's software Termika; 2) Model decomposition (breakdown) into elements – linking ADT/Excel via G-Info for BOQ calculation and material estimates and 2D drawings by ADT; 3) Publishing project web site (Mozzila composer) and final presentation (PowerPoint). All members got their task assignments with a schedule of activities with deadlines for program phases. Presence of all team members was required at the beginning of each phase (instructor exercises) and its end (group recollection). During the phases (3 or 4 weeks each), only team members assigned to specific task of a particular phase had obligation to attend exercises This way teaches students in early stage of their study valuable work skills and ethics that parallel the actual workplace.

The results

Not only main goal was achieved – a better knowledge retention, but complete process has been optimized: 2 teachers with 5 senior students handled the same number of students in 6 working hours in 1 day (in opposite to 4 shifts per 3 hours in day and a half with 4 teachers). There no need for final examine, neither. Ranking policy included not only results, but also phase deliverables in time as well. One third of teams responded to stimulation for higher marks if they would finish their project a week before the final deadline. A special stimulation to them was cash award of sponsor –Termika Company. Two teams were awarded: the best one in overall results and the most advanced regarding final results related to the pre-exercises trainings web test. New way of delivery - teamwork on a project in IT surround, with defined stimulation system – all together produced great results in knowledge acquisition with huge enthusiasm among those best one third of students. One third of students was relatively passive, which was expected, considering this course belongs in 3rd semester and most of students from that group are candidates who would not finish their study, so any way of delivery, generally speaking, would not help them out. Finally,

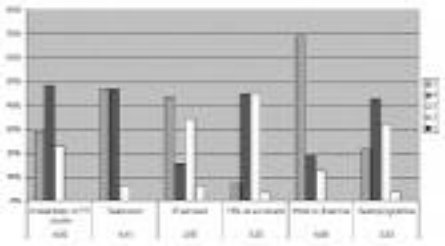

Chart 1: Student's marks of course components

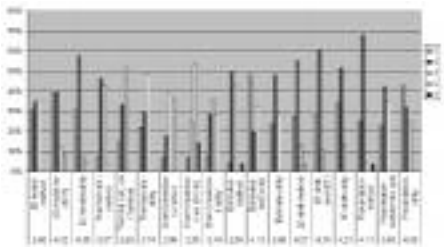

Chart 2. Student's marks of delivery components

last third-the middle one was quite satisfy with gained knowledge so it could be say that this project was quite successful with methodology and experience reusable for other course transformation in near future. The survey pool results have been reinforcing these conclusions, showing in the same time a direction for improvement. Some of gathered results are showed in these charts:

The last chart shows average hour consump-

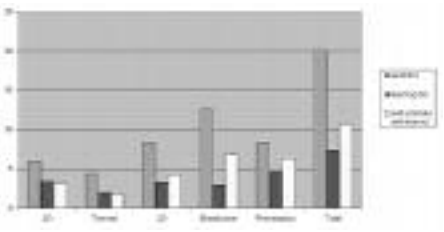

Chart 3. Average student's work loads per phase

tion for each activity. The first column represents actual hours needed for a task, the second one shows hours needed for learning about new software as well as lost time due to different reasons. The third one represent student's estimate about workload that should be sufficient for the same task in the future. This metrics will be used for future tasks optimizing as well as to rank a course in Faculty program in accordance to ECTS.

Furthermore, it's worth to say that 94% of stu-

dents expressed feeling that work in IT collaborative environment had been simulative for better knowledge acquisition; 97% found HYCE methodology more efficient that traditional one (experienced during pre-exercises trainings) and finally 84% of them found involving senior students as tutors extremely desirable.

Development plans

Plans for the future of teaching and learning environment at our Faculty rely on the well IT equipped classrooms, connected to databases of learning software, libraries, tools and other resources that might be needed for the course delivery and which could be reached through Intranet and Internet. This vision is far removed from the traditional model of delivery, which is currently in place, which relies on blackboards, books, lecture notes and a very limited use of computers in the educational processes. In recognizing that traditional modes of delivery have their place (especially when augmented by the PBL concept, which involves case studies and self learning) and that no single mode will be suitable for all situations and all courses, we will aim to develop a full portfolio of balanced and well-supported modes of delivery. Lessons from the PBL educational concepts in engineering (in particular the Aalborg Experiment), where the course content is flexible and to a large extent built around case studies related to industry will also be addressed.

The development and the implementation of the HYCE methodology in the CPD courses will be one of the main goals with the aim to improve the experienced engineers from practice, which require updating in their skills, especially in using the computer based knowledge.

References

The Aalborg Experiment, Project Innovation in University Education, http://www.auc.dk/fak-tekn/aalborg/engelsk/ last accessed Feb. 2003

Pistillo, D.: Hybrid Learning Model for Higher Education, University of Advanced Computing Technology, Tempe, Arizona, http://www.uact.edu/ Last accesed May 2003

Bond, D., Graham F. (eds.): 1991, The Challenge of Problem-based Learning, London

Flemming, K.: 2002, Problem-Based Learning in engeneering education: a catalyst for regional industrial development, World Transactions on Engineering and Technology Education, Vol.1, No.1

Butler, F., Whitehead, R., Winkelman, M.:, 2001, Student Alumni and Employer satisfaction to a collaborative learning approach, 31st ASEE/IEEE Frontiers in Education Conference, Reno