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E-Learning Support for Bologna-based Curricula for Chemical Engineering Education

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The transition of chemical engineering curricula towards Bologna Convention requirements implies a more student-oriented teaching system, with stepwise knowledge acquirements for graduate and postgraduate degrees. The flexibility of a well designed e–learning platform may offer adequate tools for customised on-line and off–line study. A comprehensive survey identified the students' needs and expectations, as well as the academic staff abilities and disponibility. The conclusions drawn will provide objective criteria for further e–learning system development.

Introduction

Higher education in Romania undergoes major changes, in order to achieve the highest possible compliance degree to the Bologna declaration and the 'communique' adopted by the Ministers of Higher Education of the Bologna Signatory States gathered in Bergen, in 2005. The challenges and priorities identified then were associated to the connection between higher education and research, social dimensions of higher level training, mobility and attractiveness of European Higher Education Area.

The legal framework has already been established in Romania in early 2005. Students enrolling for university studies in October 2005 faced Bologna-based curricula. Their educational path consists of a 3 / 4 years bachelor, a 1.5 / 2 years master, and hopefully a 3 – 4 years Ph. D degree. Students enrolled before 2005 continue to study according to the traditional curricula. This two – curricula instruction situation raises special issues, both for the students and the academic staff.

Nowadays students have a much wider view of the world than their parents, can juggle several cognitive tasks at the same time, are more relativistic and tolerant, and approach new situations and changes as a challenge. They also present a more fragmented sense of time, reduced attention span, and considerable lack of faith in institutions and explanatory narratives, reduced sense of place, community and history, and reduced vision for a personal or collective future.

Academics face particular challenges raised by the special Bologna requirements and the role played by the teacher in the ICT era (Person J., 2006, Josceanu A. M. et al., 2006, Francescato D. et al., 2007).

We have analyzed the quality assurance tools implemented so far in our university in order to asses the degree of compliance with Bologna process. At the same time we have carried out a student survey willing to identify the efficiency of changes induced by the current knowledge transfer methodology, theory – practice ratio, and evaluation of students' performance. We present the conclusions of our investigation in the academic community and the tools we propose in order to provide chemical engineering students with proper skills for the competitive European job market.

Curricula Changes According to Bologna Process

The traditional higher education pathway in chemical engineering consists of 10 semesters training, the last 5 being focused upon getting a certain degree of specialization in a sub–area such as: oxidic materials, polymeric materials, organic products, inorganic products, process engineering, and biochemical processes, environmental engineering and economic engineering. The new institutional framework provides 8 semesters for a bachelor degree in the technical field, chemical, economic and environmental engineering included. An undergraduate student will finish his/her studies with a project focused on comprehensive analysis of a technological or design case. The last 4 semesters will develop customized skills suitable for a restricted specialization, as well as general skills in the field of product and process engineering. The new curricula design has focused upon identifying the most important skills that will offer the largest option palette for the student: either to work directly in a business or to continue training with a master's or Ph. D. degree.

From the quality assurance point of view, each subject, even taught by different academics, respects a general frame consisting of developed skills, syllabus, student knowledge assessment procedures, references accessible either in the library, or as e–resources.

ICT Support Requirements for the New Curricula

According to the new syllabus, students spend less time in a university organized programme. The 28 hours weekly schedule requires intensively usage of time. There is an increasing perception within the community that teachers should find ways to teach more, better, and in less time. The dominant feeling among our staff is that the information and communication technology is a possible answer to this challenge, suitable for Chemical Engineering as well (Josceanu A. M. et al. 2006).

A large debate and a survey carried out lately in the community pointed out that teaching with ICT requires complementary skills such as:

- a certain level of comfort with computers and learning software;
- multi–task capabilities, since virtual environments often require to pay attention and work with several dimensions of teaching at the same time;
- instructional design skills that emphasize creation of interactive teaching activities.

As the interviewed academics sustain, an important role for the delivery process is played by multitask capabilities (19 %) and ICT familiarity (38 %). The dominant opinion (60 %) revealed that special aptitudes and ITC knowledge are necessary for any instructor using e-learning technologies.

Successful knowledge transfer depends both on the teaching and learning activities. They are directly affected by human characteristics such as subject's experience, educational environment, background knowledge, sensorial and processing abilities, and cultural background. There are slight differences in the importance given to these variables by certain teacher generations in the faculty. While readers or professors signal the almost equal importance of background knowledge (figure 1), cultural background, and sensorial and processing abilities for learning, younger colleagues give more credit either to educational environment, subject experience or sensorial and processing abilities.

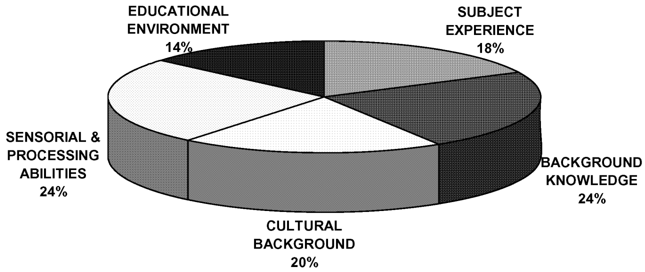

Figure 1. Success factors in the teaching-learning process

The main large scale changes in teaching, as compared to the previous three years have concentrated on ensuring minimum ICT literacy for students so that they handle calculus applications and projects, literature specialized search for home assignments, and different level computer usage for scientific text editing (mathematical and chemical formulas), data analysis by graphs and tables.

As concerns the students' needs according to their own opinion, ICT can be a useful tool both for individual work and class teaching. Nevertheless, we have noticed some slightly different options expressed by students in the first or second year compared to those in their last training years. Sophomores prefer a classical way of teaching, with detailed expression derivation on the board, especially in mathematics or physics. PowerPoint or other type of animated presentations are more appealing to students in the third and fourth year, especially in subjects were equipment types are presented, or design methods based on graphical representations are discussed. The extensive usage of specialized software in working classes is appreciated by all students. Data analysis is considered much easier when using ICT tools. Increasing ICT literacy is also regarded as a complementary and useful skill to be developed.

The attitude towards home assessments and individual study is in general well perceived by our students. They feel that an on the spot evaluation of their results will help them in finding better learning approaches and validate their correct understanding of the material currently taught.

All students use lecture notes and recommended reading texts as mainstream information source, but they also find the academic staff explanations, guidance, and comments very useful. As regards laboratory and seminars, they are considered equally useful if the working groups are small, so that the academics in charge can help them to improve their computation skills in seminars and manual skills in laboratory work.

The current e–learning challenges in the Faculty of Applied Chemistry and Material Sciences are not only the quality of the software launching, tracking, and reporting on educational materials. They are linked to the educational materials themselves and the communication channels existing between the partners in the educational process: developer, teacher, and student. Our students have started signalling that sketchy

PowerPoint presentations more harm than serve teaching goals. Given their characteristics, it is crystal clear that real interactivity is required.

e–Learning Platform as Support in Delivering the New Curricula

SeLFT, the e–learning platform running in the Faculty of Applied Chemistry and Material Science since 2004 (Josceanu A. M. et al., 2005, Onofrei R. et al., 2005, Plesu V. et al., 2004) proved a fairly good training and assessment tool for the students studying for a chemical engineering degree according to the five year curricula. Beyond the interest showed by members of the academic community, its usage was restricted within the faculty site. Students accessed recommended subjects in the library and entered the virtual classroom mostly during examinations periods. They appreciated the evaluation transparency, despite the stress experienced when unintentionally hitting keys that cut them short from the evaluation process. The idea of offering larger access to the educational content in terms of location and time has been risen from the early days of SeLFT usage. Once negotiations for implementing the 4 year curricula started, platform developers studied the possibility of extending it as support for personal instruction outside scheduled classes, be they real or virtual, and semester examinations. An off–line study module was designed and integrated in the platform, so that synchronous and asynchronous type instruction is now available for users. While synchronous courses were available from the first platform implementation in the faculty, asynchronous courses are available now in two forms: off–line (students are enrolled by the trainer) and open courses (where students enroll themselves, from the forum module).

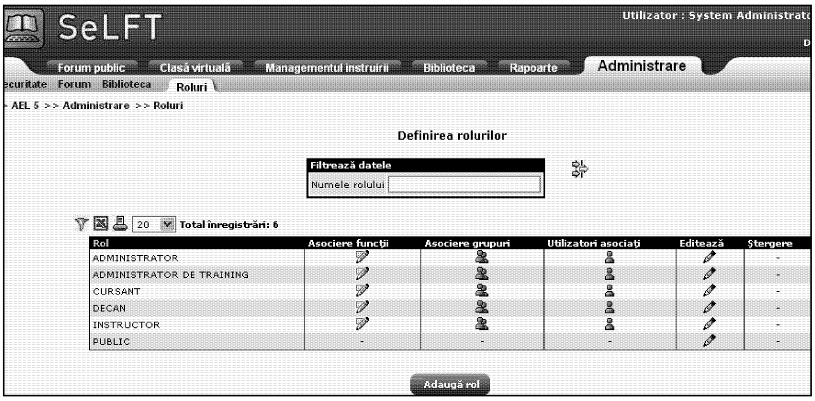

Figure 2. Establishing roles within the enlarged SeLFT platform

Roles remain customized, including, apart from the before–known system administrator, student and trainer, a training manager. Accounts, security, roles, and general privileges are still prerogatives of the system administrator (figure 2); he also defines a set of positions according to the educational (student, professor, reader, lecturer, assistant) or administrative (laboratory assistant, secretary) system available from a predefined list of job titles.

The training manager defines user groups for a specific off–line course, with their corresponding privileges in terms and functions. The training manager introduces new courses, specifying name, code, domain, trainers, time interval, as well as a participating message for enrolled students (figure 3).

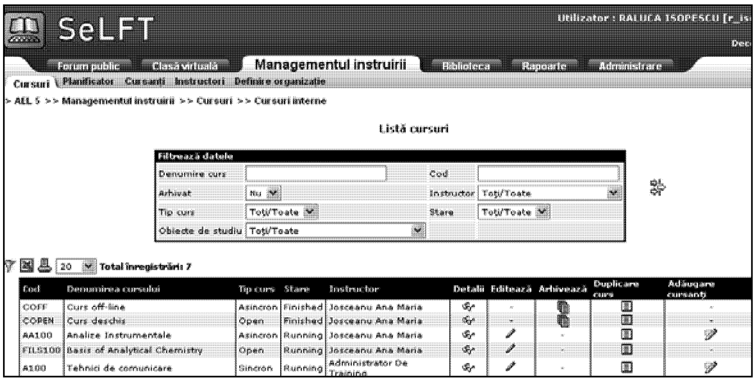

Figure 3. Course editing by training manager in the courses list.

Even auxiliary courses, offered by other training organizations (academic and industrial) can be accustomed, provided that a secured link is established for the trainer in the outside organization.

Organization definition in terms of study domains, virtual and real classes becomes the job of each trainer. He/she also specifies the enrolment tine interval, the maximum number of students, passing criterion, maintaining previous duties of creating course supports either by in the platform editing, or by importing relevant Word', 'PowerPoint', 'pfd', 'html' resources in the 'library' module. Test type components can be included in the course support, extra information regarding passing limit, test type (final, intermediate and/or compulsory), marking protocol (automated, direct) and results presentation (direct, gradual, qualification), figure 4.

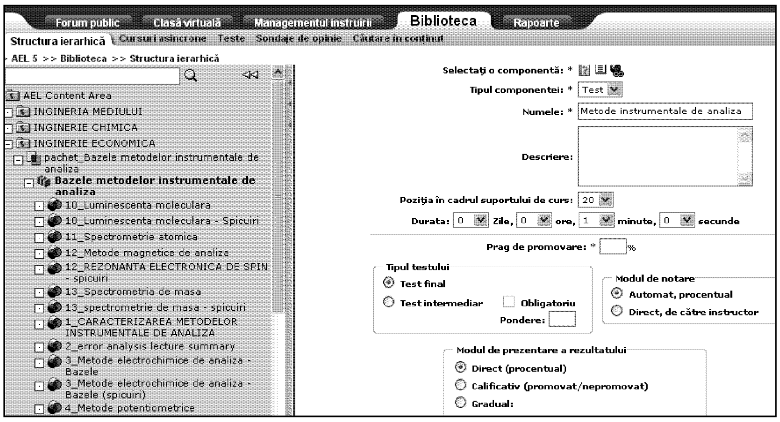

Figure 4. Test editing in the library

The student possessing a valid user account and password has visualization rights in the forum, virtual class, training management, library and reports modules. Within the training management he/she gets information about the available courses and can enroll to the open ones. The student has access to certain asynchronous courses in the library, scrolling the information free or sequential (with no chance to revisit previous components–figure 5). Available components are shown by active text and arrow. The 'Reports' module offers valuable feed–back for both students and trainers. The whole activity of a student, both for synchronous and asynchronous modules is available, the participation history in terms of courses surfed and tests submitted.

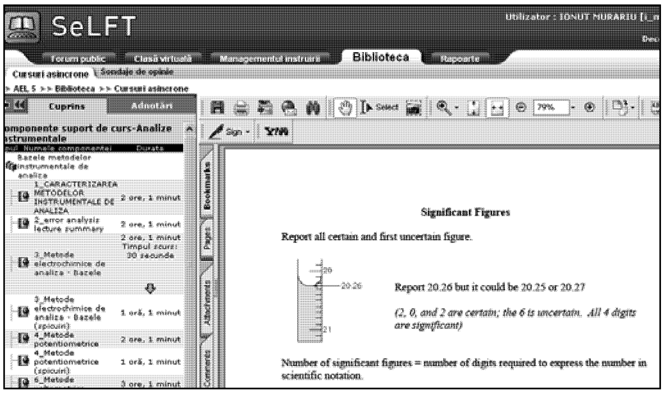

Figure 5. Asynchronous course scrolling in the sequential mode by student Murariu

The trainer has also presence and performance reports for whole groups and individual students as well. It is also possible to check on the students using an asynchronous course support for a given time interval. Information on tests is available from the ‘tests archive’. It is fairly easy to discriminate between synchronous and asynchronous given tests, as the latter are carried out only from the library. The trainer may add comments and recommendation for certain problems in a test, thus leading to increase students’ performance. Students have full access to this information in the library menu, as well as access to most of the recommended extra reading (by direct link to the OPAC in the university library).

Conclusions

The curricula changes for the chemical engineering degree affect performances within the academic community. Students ask actively for more independence in studying. Therefore efforts concentrate upon modifying teaching approaches, even for technical education. An e–learning platform with suitable off–line study features can provide a support tool for teachers in chemical engineering. Students’ response to this new tool is encouraging and more enthusiastic than that from the more conservative academic community.

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