E-learning Environment Integration in the Chemical Engineering Educational Process*

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This paper introduces the electronic Portal, reports on the experiences of its use, shows how it motivates students towards more successful study, encourages lecturers to give better lectures, enhances learning, and so reduces workloads. A group of students from the Department of Chemistry and Chemical Engineering in Maribor have used this Portal in their Process Synthesis Course for the last four years. Their responses to e-learning and the Portal were collected by means of a questionnaire. The students thought that the Portal was an effective tool that helped them to improve the quality and efficiency of their studies. They thought a combination of lectures and e-learning to be the most suitable solution for them because it gives a freedom of choice in methods and time devoted to studying. They suggest that this kind of arrangement would be beneficial for use in the future. These statements could motivate college students to choose studies at departments that use modern technologies within the educational process and thus increase the enrolment in those departments. The faculties' responses to using the Portal are also presented. The results of their questionnaires were not as encouraging as the students'. A few lecturers had already used certain functions of the Portal but, in general, they thought that the incorporation of e-learning into the educational process means a heavier workload and is time-consuming. Perhaps the experiences of the lecturer for the Process Synthesis Course, who has been using e-learning for several years, will demonstrate that the incorporation of e-learning into the educational process leads to a heavier workload at the start, but this reduces over time. Perhaps this experience will encourage the faculty to reconsider.

Keywords: ICT, electronic tool; e-learning; chemical engineering courses

INTRODUCTION

NOWADAYS, with the faster tempo of life, it is necessary to optimize our study time. This paper shows how the lecturer of the Process Synthesis Course at the Department of Chemistry and Chemical Engineering, University of Maribor, in Slovenia has incorporated e-learning into the educational process and how the students have accepted this. The results show how e-learning can improve lectures, reduce a lecturer's workload and motivate students to obtain better study results. These three activities are the main reasons for incorporating e-learning into the educational process. The electronic Portal is used to achieve this. It is available to all members of Maribor University and is suitable for e-learning.

This paper describes the Portal's structure, its functions and its use in the Course on Process Synthesis. Results of questionnaires are included, voicing the benefits of using it and its influence on the quality of study and lectures. These results were obtained on the basis of two questionnaires completed by students who took e-tests during the Course on Process Synthesis and the faculty.

Alternative approaches to education

At the beginning of the 21st century, a group of

eminent professors of chemical engineering [1] announced that, in the very near future, it would be almost impossible to carry-out the educational process without incorporating better teaching methods. Their statements might have sounded strange to lecturers who had conducted lectures in the traditional way year after year without any problems. In fact, they had not changed the contents of their teaching materials for many years. The main goal was to explain, then write, and then solve some examples on the blackboard. Students listened and wrote down notes. They were passive listeners.

Five years ago Slovenia became a full member of the European Union and the European University Area. The Bologna Process, to which the members of this area are bound, encompasses a unique model regarding studies. This has meant reassessing and changing the traditional curricula towards a single study structure within European Universities. In general, this has meant reducing the number of lessons so that the average student is able to complete his/her studies within five years. After completing their studies, students should then be fully acquainted with professional knowledge and skills, such as oral and written skills, critical and creative thinking, problem-solving methods, teamwork skills and new learning technologies. Some lecturers have realized that something should be done regarding the educational

process if our students are to become widely qualified. The traditional methods of lecturing and learning are becoming inappropriate for both lecturers and students. The lecturer will simply have insufficient time for explaining all the material, in the classroom. There will also be a lack of time for solving problems on the blackboard. That means that students will need to take greater responsibility for their own knowledge and non-traditional methods, such as active learning, cooperative learning, problem-based learning, project-based learning, and e-learning, will be the most important activities regarding a more efficient educational system.

Many lecturers [2−6], who already used active and co-operative approaches to teaching have already recognized that students became closer to their colleagues by learning from and helping one another, and that they also learn to communicate and respect each other, which is essential for obtaining good results.

Nowadays, when a lot of effort is being put into information and communication technological (ICT) use, e-learning can considerably improve the educational process. Different electronic environments offer various possibilities for such learning. When appropriately applied, they can effectively supplement the non-traditional methods mentioned above.

Many institutions worldwide already use different kinds of e-learning environments in their educational processes [7−10]. The results have shown that such technology stimulates and motivates students' interest in the subjects, improves their learning performance within the discipline of industrial engineering, and greatly improves teaching and learning, whilst saving time and money in all aspects of the classroom. Weblabs, for example, provide students with training in working with experimental equipment. Such laboratories drastically reduce the economic necessity of providing new equipment, and stimulate skills such as teamwork, communication, and presentation [9].

EU universities can be categorized into four categories concerning their current use of ICT for organizational and educational purposes [11]:

1. front-runners (16%);
2. co-operating universities (33%);
3. self-sufficient universities (36%), and
4. sceptical universities (15%).

The level of faculty resistance to ICT at the University of Maribor currently lies between the third and fourth categories. On-line course registration is used, e-learning and co-operation with other universities are limited, and several sceptical lecturers can be identified in most departments. This scepticism about e-learning among the faculty could be present for the reasons set out below.

- They doubt the real usefulness of such learning and teaching, and its influence on the quality and efficiency of study.
- They know or are convinced that using ICT means putting a lot of time and effort into this area.
- They are convinced that over time their research work and cooperation with industry would be of lesser importance.
- Some of them, especially senior professors, might be concerned about any new workload because they can no longer easily adapt to change.

However, in reality, lecturers will decide for themselves when, and to what extent, this new approach of education could be incorporated into their courses.

The e-learning portal (at the University of Maribor)

E-learning at the Department of Chemistry and Chemical Engineering in Maribor is in its infancy. The electronic Portal was incorporated into the educational process for the first time during the academic year 2004/2005. Its use was briefly presented at CHISA 2006 [12].

The Portal was developed at the Department of Electrical Engineering and Computer Science in Maribor and is available to all members of the University free of charge. One of the main goals was to develop a simple but effective environment for such a learning method, which could be used by all lecturers and students as a communication tool. The possibilities for use that are available to a lecturer vary for his/her course.

The Portal is composed of the following functions: course review, course editing, basic group, group editing, term editing, sending messages, result insertions, forum, chat and 'my courses' [13]. A brief explanation of the functions follows.

- Course review tool enables the lecturer and the student to see all the entered data.
- Course editing tool enables the lecturer to enter all significant data concerning the Course. These data are: Course title, available time in hours (lectures, practical sessions), year of study, course year, student's obligations, practical session obligations, exam criteria, other obligations, links, chapter list, literature list, diploma assignments list, colloquium list, dictionary of terms, and a list of frequently asked questions.
- Basic group tool enables students of the University of Maribor to access the Course.
- Groups editing tool enables the lecturer to organize students into groups for practical work in the laboratory, co-operative learning, etc.
- Terms editing tool enables the lecturer to establish terms for different learning activities, e.g. practical work in the laboratory.
- Sending messages tool enables the lecturer to send all kinds of messages concerning the course to students.
- Result insertion tool enables the lecturer to insert exam results.
- Forum tool enables asynchronous communication between the lecturer and his/her students.

- Chat tool enables synchronous communication between the lecturer and his/her students.
- My courses tool enables the lecturer to see the list of his/her courses over the academic year (current, past).

In many universities electronic tools such as Blackboard [14], WebAssign [15] and Moodle [16] are used in order to assist lecturers in improving and assessing their courses. They are fairly sophisticated and provide more aids than our Portal, such as randomizing electronic tests to give different tests for different students, a time limitation for the tests and so minimize the like hood of copying and additionally influencing the study and workload. The benefits of having our own electronic tool for educational purposes are, for example, that we do not need a licence for it, and the experts who developed the tool are available whenever necessary to improve certain functions of the tool, to rectify errors etc.

2004/2005 was the first academic year that the portal was used in our Department (Course on Process Synthesis) and the preparation of relevant material took up a great deal of the lecturer's time, and only some functions were used, namely course editing, course reviewing, and sending messages. The main task of the lecturer was to prepare multimedia documents such as solution manuals and questions for oral exams, which were designed to help the students to prepare for their exams. In addition, an electronic testing (e-test) was prepared and conducted. The students passed with very good results. With regard to laboratory work, the Portal offered students a multimedia video presentation of the tubular reactor that they later used themselves in the laboratory. In this way they became familiar with the operation of the reactor, the important main operating parameters, and the analytical method to be used for determining the final results, such as the conversion of the reactants before they came to the laboratory. The Portal was also incorporated into certain other courses, and almost all functions were efficiently used during the academic year 2005/2006.

As the Portal was initially a novel educational process, it was very important for the lecturers and the department to obtain feedback from the students. The groups of third year students following the professional higher education programme in our Department, who had used the Portal and passed the e-test well over a three year Process Synthesis Course, gave their opinions about the Portal and e-learning by completing a questionnaire. It comprised ten questions, eight of which were multiple-choice type questions and two were essay-type questions. They can be categorized into two areas:

1. an opinion of the Portal and its application and
2. a general opinion of e-learning.

The questions and answers are shown below, as well as comparisons of the results presented for the academic years 2004/2005, 2005/2006 and 2006/2007.

E-TESTS APPLICATION

In addition to the functions already mentioned, the Portal offers students the opportunity to take tests electronically. This is a challenge for lecturers and students, but it leads to an improvement in lectures and student learning, and reduces the lecturers' workloads.

Several options exist for using e-tests, as set out below. Some of them are described. It should be pointed out that the results of using e-tests mainly depend on the capability of the electronic tool and not on lecturers' or students wishes'. The options are listed below. On the basis of discussions about each option, the following advantages and disadvantages of electronic learning were identified:

- *Using e-tests primarily for summative purposes, i.e. helping to determine course marks.* This option reduces the lecturer's time taken over oral or written exams, i.e. checking and grading, when teaching large classes or several smaller classes within the same academic year.
- *Using e-tests primarily for formative purposes, i.e. helping the students improve their understanding of course material but playing a minor role in determining course marks.* Because students get feedback immediately as to their knowledge, they can better prepare for oral or written exams. They usually get extra bonuses, which increase their course marks. E-tests can be taken at different locations and at different times.
- *Allowing students to take e-tests individually whenever they choose.* In this way students can optimize their time for study, can better prepare for the e-tests and can even get help from their colleagues.
- *Allowing the students to take e-tests in class at a specified time and place.* This option minimizes the likelihood of copying but introduces a certain limitation for students regarding when or where to take an e-test. When e-tests are early in the morning, a student could be too late and lose the opportunity to take it again.
- *Administrating each e-test once.* This option encourages students to work seriously and is appropriate for studying smaller portions of the course material.
- *Offering the possibility of retaking the e-test to improve understanding of the course material.* After taking e-tests, students receive feedback immediately, obtain more information on the subject matter and study those parts of the course material for which they did not obtain good results. E-tests improve their knowledge gradually.
- *Including mainly simple factual items in the e-tests.* In this case verification of knowledge is limited but students learn the essence of the

chapters' material. Additional verification of their knowledge is needed, for example in oral exams. The electronic tool need not be highly sophisticated.

- *Mainly the items that test true understanding of critical course concepts should be included in the e-tests*. This option needs a highly sophisticated electronic tool. During such an examination, e-tests give students critical views about the required knowledge. After such an e-test, students pass written exams without significant problems.
- *Including within the e-test, both simple factual items and items that test a true understanding of critical course concept*. Highly sophisticated electronic tools are needed in this case. After taking e-tests, students are well-prepared for problem solving; they know what the essence of the chapter's material is and preparation times for written exams are shorter.
- *Giving the same e-test to everyone*. This option reduces the lecturers' time when preparing questions but, on the other hand, increases the possibility that students of the subsequent classes will be warned what to expect in the e-tests.
- *Randomizing questions to some extent in order to reduce ease of copying*. This option enables the lecturer to also supervise large groups of students when taking e-tests in the computer room. An e-test bank of questions is needed as well as a sophisticated electronic tool for delivering them randomly.

E-tests at the Department of Chemistry and Chemical Engineering, University of Maribor were incorporated into the educational process for the first time during the academic year 2004/2005, within the Process Synthesis Course. This Course takes place during the second semester of the third year, and is a higher professional programme. Lectures are given twice a week (5 hours every week). The lecturer explains the main points of the material, and the students learn the rest by themselves. After each chapter they solve problems in groups of 3 students and the majority take e-tests. In addition to cooperative work in the classroom, they have homework to do in the same way. The final mark for the Course is composed of two marks. The first mark is obtained for theoretical knowledge and is composed of three parts: homework (20%), oral exam (40%) and written exam (40%). The second mark represents practical knowledge and is composed of laboratory (50%), and computational work (50%).

The oral exam can be taken in two different ways:

1. traditionally, by answering questions that are asked by the professor on the whole course material, usually in his/her office; or
2. by passing an electronic test after each textbook chapter of the course.

One reason why the lecturer of the Process Synthesis Course also offered students a non-traditional choice of taking the oral exam with e-tests was to reduce the time needed for it. Some students needed several months to study the theory. They usually said that the content of the course material was very extensive and for that reason a great deal of time was needed to absorb the theory. Another reason was to reduce the lecturer's workload for checking and grading every student who took the oral examination. It usually takes about an hour for each student to pass the oral exam if he/she is well-prepared or even longer if they are unprepared.

Interest in e-testing, in preference to taking the traditional oral exam, increases from year to year. During the academic year 2004/2005 only 12 students (or 46% of the regular enrolled students in the class) decided to use e-testing; in 2005/2006 23 students (or 79%) used it, while in the academic year 2006/2007 29 students (or 93%) opted for e-testing. The application of e-tests during the Process Synthesis Course was presented in detail at CHISA 2008 [17]. E-tests are taken after each chapter of the textbook, i.e. approximately twice a month, one hour before regular lectures, and in the Department's computer room. All e-tests include more than 60 multiple-choice type questions of different kinds. Questions are independent of each other. Everyone in the class is given the same e-tests which are, in some parts, different from those of previous classes. Every year the lecturer adds some new questions or changes some questions or corrects questions from the previous years. Each e-test is administered only once. It is forbidden to write down the questions on the paper. This prevents any circulation of questions to subsequent classes. The student is successful if at least 60% of the answers are correct. The written exam is carried-out at the end of the semester and the student must be familiar with the whole course material. Because students are already acquainted with the subject theory, they usually pass the written exam without any major problems.

During the academic year 2006/2007, e-tests were also incorporated into two other courses in the second year of study, i.e. Process Balances and Process Calculation. E-tests were prepared for self-assessment of knowledge before the oral exam and were active from the 1st June until the 1st October, i.e. over the whole summer examination period. Students who passed all the e-tests successfully obtained extra bonuses on top of the final exam mark, which are stimulative awards. The reasons why e-tests did not also replace the traditional oral exam in the second year of study were as follows:

- in some parts, the course material was unsuitable for multiple-choice type questions;
- the group of students was too big (more than 50 students), and the computer room was too small;

- because e-tests had to be the same for all students, it would be difficult to supervise such a large group of students when taking the e-test, in order to prevent any likelihood of copying.

Almost half of the regularly enrolled students (46%) who needed to pass the Process Balances Course and 33% in the Process Calculation Course took e-tests before their oral exams. They said that:

- with e-tests they learned the essence of each chapter, and
- e-tests gave them a critical view about the knowledge.

In the near future we will try to remove some of the disadvantages, such as e-tests being administered only once and everyone in the class being given the same tests. With the possibility of retaking e-tests student will additionally improve the study. By using randomly delivered questions, the likelihood of copying will be reduced and the e-test's mark will be a more realistic part to the final course mark. For our Department, the above changes would mean an improvement in the present Portal configuration, or the necessity of obtaining another, more sophisticated electronic tool.

STUDENT'S RESPONSE TO THE PORTAL'S APPLICATION, AND E-LEARNING

In order to obtain feedback on the usefulness and applicability of the Portal, students who successfully completed all e-tests (11 students from the 2004/2005 class, 20 students from the 2005/2006 class, and 25 students from the 2006/2007 class), filled-in questionnaires and answered certain questions. Table 1 shows all the multiple-choice type questions, number of respondents in each class, and the fraction of respondents to each question. An explanation of the results follows.

The differences in answers to the first question from the three classes of students were significant. In 2004/2005 class, e-learning was almost unknown to students, in the 2005/2006 class approximately one half of students knew (15%) or partly knew of (30%) e-learning, but the 2006/2007 class all knew it well (40%) or fairly-well (16%). The results show that information about e-learning within the educational process has advanced from year to year.

In general, the lecturer was the main source of initial information about e-learning, in all classes. The last class (2006/2007) also received information from their friends and older colleagues who had used the portal in previous years. Although local radio and television broadcast some information about such education from time to time, it was basically insufficient. The results show that this kind of novelty permeates through the educational process very slowly.

Interest in the Portal decreased slightly during the class of 2005/2006, and increased again for class 2006/2007, in comparison with the class of 2004/2005. Class 2004/2005 did not find the Portal difficult to use at all. In the class of 2005/2006, 5% of students thought that using it was difficult, and 25% fairly difficult, but in the class of 2006/2007, only 16% declared that using it was fairly difficult whilst 84% found it not at all difficult. The results about the interest and difficulties of using the Portal could be explained in the sense that the structure of the Portal was simple and attractive for users and that students had different abilities and interests for such a type of learning.

Furthermore, the class of 2004/2005 had less problems than that of 2005/2006 when working with the Portal, and the class 2006/2007 had almost no problems. Sometimes the system crashed, particularly in the mornings when all the users (students and the faculty) came to work, switched on their computers, logged on at the same time, and started to use the Portal.

From the last two classes, students were asked about using the Portal in other Courses. The results were very surprising. The majority of students did not know that the possibility existed for using the Portal in other Courses. Perhaps they had not attended the lectures when the information about portal application was given or they did not pass the exams for those Courses before filling in the questionnaire. One of the most useful functions of the Portal is its result insertion tool, which enables the lecturer to insert the results of exams to all registered students. In this case, students need to use the Portal.

The independence of the students was evaluated on the basis of two questions which referred to e-testing, and oral and written exams during the Process Synthesis Course. The 2004/2005 class was more independent when studying than the 2005/2006 and 2006/2007 classes. More than half (55%) of the students from class 2005/2006 thought they could not have passed an e-test without attending lectures, while in classes 2004/2005 and 2006/2007 about one third of them thought so. This conclusion makes it obvious that, in spite of modern technology being incorporated into the educational process, personal contact between the lecturers and students in the classroom will still remain important.

Similar results were obtained when the students were asked whether they could pass both oral and written exams without attending lectures. In this case the main goal was to find out whether students were equally independent when preparing for written and oral exams. The 2004/2005 class showed more independence regarding study than the classes of 2005/2006 and 2006/2007. About one third of the 2004/2005 class thought they could pass the exams without attending lectures, while none of the class 2005/2006 and only 8% of the class 2006/2007 thought so.

The results of the last two questions show that a combination of traditional and electronic methods

Table 1. Questionnaire results from three classes of the Process Synthesis Course

N*	Class	Fraction of respondents to the question (%)						
		Yes	**No**	**Partly**	**Medium**	**Internet**	**Lecturer**	**Others**
		Did you already know about e-learning before using the portal?						
11	2004/2005	9	82	9				
20	2005/2006	15	55	30				
25	2006/2007	40	44	16				
		Where or from whom did you obtain your initial information about e-learning?						
11	2004/2005					9	91	0
20	2005/2006					0	100	0
25	2006/2007					8	72	20
		Do you find working with the portal interesting?						
11	2004/2005	91	0	9				
20	2005/2006	70	0	30				
25	2006/2007	96	0	4				
		Is using the portal difficult?						
11	2004/2005	0	100		0			
20	2005/2006	5	70		25			
25	2006/2007	0	84		16			
		Did you have any problems working with the portal?						
11	2004/2005	18	82					
20	2005/2006	30	70					
25	2006/2007	4	96					
		Have you also used the portal for e-learning during other Courses?						
–	–	–	–					
20	2005/2006	20	80					
25	2006/2007	16	84					
		Do you think that you can pass an e-test without attending lectures?						
11	2004/2005	36	28	36				
20	2005/2006	15	55	30				
25	2006/2007	24	32	44				
		Do you think that you can pass both oral and written exams without attending lectures?						
11	2004/2005	27	73					
20	2005/2006	0	100					
25	2006/2007	8	92					

N—number of respondents.

of education will be necessary in the future. Students are obviously more independent when learning the theory of the Course, but less when solving problems. For this reason, good lecturing and co-operative solving of problems in the class-room will remain irreplaceable, perhaps not for the whole Course, but definitely for the more difficult subject matter.

When one looks at the questionnaire results carefully (Table 1) showing the differences in the answers of the 2005/2006 class compared with the other two classes, one may come to the conclusion that the students of the 2005/2006 class were not very interested in electronic tools and that they preferred traditional lectures. This was perhaps the reason they found use of the Portal fairly difficult and it caused greater problems. It is possible that some of them did not even have computer or internet connections at home. Some students were (and still are) from socially-deprived families and could/can not afford to buy a computer. For this reason, it is understandable that they did not have as many skills when using electronic tools as others who had computers and internet at home.

The statements in this paragraph are just presumptions and have not been verified.

At the end the students were asked what they would change and what they found most interesting or useful for learning when using the Portal. A variety of suggestions and statements were expressed because the answers were in essay form. In the main, students would not change anything about working with the Portal. Some of them suggested using the Portal during other Courses, which would simplify their studies, and others expressed the need for additional exam problems from previous classes, and for short Course notes. In general, students pointed-out the following advantages:

- updated information about the Course;
- independent study;
- all the data collected in one place;
- electronic text-books;
- the results of the e-tests are known at once;
- different methods of passing the oral exam (chapter by chapter).

They can print out, for example, solution manuals, questions for the traditional oral exam, chapters of

text-books, dictionary of terms etc, whenever they want to and lecturers can send messages to them.

This academic year (2007/2008) all regular students (23 students) who needed to pass Process Synthesis Course chose electronic tests. At the end of the course they answered some additional questions concerning e-learning and the Portal. In one question the lecturer wanted to know *whether the Portal and its functions had helped them to improve the qualities and efficiencies of their study*. The majority of students (65%) thought that the Portal had improved both the quality and efficiency of study, 4% of them thought it had not improved them and 31% did not say anything. One student replied: '*On the Portal I found everything I needed for the course at any time. I did not need to come to the Department to find out what was new or what I needed to know or go next week to the lectures. I could stay at home and do other activities*.' Another student said: '*I needed to print-out the course material by myself at home and then I put it in order. In such a way I already remembered some parts of the material*.' Another replied: '*Passing the exam using the e-test is definitely less stressful. I can better concentrate on the questions. One does not need to learn as much theory at once, but chapter after chapter. I understand the theory acquired better in such a way and it stays longer in my memory*.'

The lecturer also wanted to know *whether they could express their knowledge satisfactorily using e-tests*. Some (70%) students replied 'Yes'. Among these were probably students who were shame-faced or felt embarrassed when confronted by the lecturer. Some students (26%) replied 'Partly'. They thought that it depended on an individual person and his/her capability. One student (4%) thought that he could not express his knowledge satisfactorily using the e-test. The reply of one of the students was interesting: '*Several correct answers among many possibilities encouraged me to think carefully and eliminate the wrong answers*.'

Finally, the lecturer wanted to know *what manner of work would suit them at lectures in general*. The majority (78%) said that the manner of work as used during the Process Synthesis Course suited them. It meant active and cooperative work in groups, electronic assessment of knowledge, homework obligations, and the written exam. Some students (22%) did not answer the question. One student thought: '*Such a manner is good because the work is diverse. Lectures are not tiresome*.' The other said: '*I liked such a way of work. The cooperation with my colleagues was helpful. I asked them and they asked me if something was not understandable. After lectures I understood everything*.' It was also interesting what one of the students said about learning the theory. '*If I acquired the theory chapter after chapter, it was easier to solve problems and pass the written exam. Otherwise, at the written exam I did not know much about the theory*.'

The results of the questionnaires from the last four years show the future of Process Synthesis education, and perhaps of other courses. Students accepted electronic education as the Portal offered but they thought that without lectures and cooperation with colleagues and professors it would be harder to pass the exam. They are interested in changes especially when they can improve the quality and efficiency of study. This is understandable because they are young, they want to be successful and they want to adapt to the challenges they will encounter in the future.

Because the assessments of the Portal and e-learning were obtained only on the basis of administered questionnaires with students who had taken e-tests, they were not totally objective because other students who did not take e-tests were excluded. In the future it would be helpful to compare the performances and attitudes of students who did and who did not use e-tests. In such a way it would be clearly evident whether uses of the Portal and e-learning have an observable effect on students' learning, or not.

What is of crucial importance, however, is the response of the faculty to the portal application, which is not as stimulating.

THE FACULTY'S RESPONSE TO THE PORTAL APPLICATION

As pointed-out in the Introduction, most of the lecturers at the University of Maribor are sceptical about the use of ICT. Since e-learning will probably be an important and useful tool in the educational process of the future, it is interesting to know what the faculty responses are to using the Portal for educational purpose in our Department. The answers to the questionnaire and opinions, which lecturers and assistants completed at the end of the academic year 2005/2006, were based on seven questions. Three of them were multiple-choice type questions and four were essay-type questions. A copy of the questionnaire is given in the Appendix.

The questionnaire was sent to 28 persons and only 14 of them responded. The results showed that half of the faculty was completely disinterested in this kind of work or that they were so occupied with other duties that they had no time to answer the questionnaire.

In answer to the question '*Do you know that the Portal for e-learning is available to all members at the University of Maribor?*' the majority of the responding staff (78%) knew about it and 28% had never heard of it, in spite of all the presentations. Owing to the lack of knowledge and interest in e-learning, only half (55%) of the faculty who knew about the Portal started using it during the 2005/2006 academic year, while the remaining 45%, who also knew about the Portal, did not bother to use it.

The faculty was also asked in which Course they used the Portal. It was actually a request addressed to lecturers and assistants to write down a list of Courses where the Portal was included, possibly as an electronic tool for implementing lectures,

exams, exercises etc. The following is a list of all Courses for which the Portal was used during the academic year 2005/2006: Process Balances, Process Calculation, Process Synthesis, Mathematics, Process Dynamics, Process Optimization, Economics, Material Science, Chemical Reaction Engineering, Process Safety, Process Development, Process Design and Computer-Aided Process Design.

The answers to the question '*Which functions of the Portal have you been using?*' were quite different. Some lecturers used only the *course editing* function, where basic information, e.g. students' obligations, exam criteria and colloquium list, were explained to the students. The most useful and popular functions were *sending messages* and *results insertion*. The first one enabled the lecturer or assistant to send all kinds of messages concerning lectures, exercises, lecturer's absence etc. to students. The second one was useful because a list of all undergraduate students already existed on the Portal, so it was easy for lecturers to send colloquium or exam results to each of them. Two lecturers had prepared some multimedia documents (e.g. text-books, questions for oral exams, e-tests for verifying knowledge), and a list of literature to be studied for the exam.

One of the questions was the same as the one addressed to the students. It referred to the difficulty in using the portal. Four users said it was easy, two of them thought it was time-consuming, not very user-friendly, and in some parts, difficult to understand. One user found working with the Portal difficult. Others of those who filled in the questionnaire, had no comments, which could mean that someone else (e.g. postgraduate students) handled the Portal for them.

The question, which referred to work with the Portal over the following academic years, was: '*Will you use the portal over the following academic years?*'. Eleven respondents replied 'yes', one did not know at that time, and two gave no answer.

Finally, users were invited to write down their opinions and proposals for working with the Portal. Those who had not used it needed more information. Others thought that using the Portal for only one academic year was insufficient for constructive suggestions.

It is obvious that there is resistance to use of the electronic tool among the faculty. The question is how to tackle this resistance. Actually, there are no general instructions on how to do this. Surely, one of the important things that is needed is constant encouragement from the faculty towards the new way of education from the more experienced lecturers. Furthermore, proper help for first-time users, e.g. short tutorials, is necessary. Assistants or postgraduate students could help the lecturer to prepare the related material such as text-book, manuals and e-tests, and to send out exam results. The experiences obtained when working with electronic tools must be continually circulated. It is also important that the lecturer talks about e-learning with students during his/her Course and carefully listens to their requirements.

In any case, a great deal of effort, time, explanation and good-will from the academic staff will be necessary in the future to attain a balance between the students' wishes and the faculty's activities.

CONCLUSIONS

Undergraduate study reform will place students at the centre of the educational process, so non-traditional methods, such as active teaching and learning, cooperative learning, project work and e-learning will play important roles. Students should be more independent when learning, doing research work, writing reports, etc.

The results from the start of e-learning at the Department of Chemistry and Chemical Engineering in Maribor are evident. The last four intakes of students have used the university Portal for different courses where they could find tools for study, such as text-books, test examples from previous years, questions for oral exams, exam results, e-tests, etc. They obtained benefits from study when working with the Portal, e.g. the possibility of assessing their own knowledge, and the results of e-tests are available immediately. In this way they can prepare themselves better for oral exams. Electronic tests made it possible to study course material chapter after chapter and decreased the time needed to pass an exam. It shortened the lecturers' examination times, too.

The questionnaire completed by students of the last four years studying the Process Synthesis Course revealed that a combination of classical, non-traditional and electronic teaching and learning was best for them. This combination preserves the personal contact between the lecturers and students but also ensures the freedom to choose the time for study. The incorporation of e-learning into some courses showed that such a way of working could increase the quality and efficiency of the study and reduce some of the lecturers' workload. Although the students had not come across such a system of working before, they suggested that it would be suitable for use in the future.

However, the enthusiasm for introducing novelty into the educational process is not as great among the faculty. Only a few of the lecturers incorporated e-learning into the courses. To some extent this can be explained by the fact that every change means more effort and workload, and requires additional time. It is necessary to point out that novelty and innovation should be introduced gradually, or they might lead to stressful situations. Therefore, students should be introduced to the innovations gradually by the lecturers or students in the years above. In this case, lecturers and other pedagogical staff would have sufficient time to prepare complete material and activities for Courses.

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APPENDIX

Questionnaire presented to the faculty in electronic form

1. Do you know the Portal for e-learning is available to all members at the University of Maribor?

   Yes   No

2. Have you used the Portal for e-learning during the academic year 2005/2006?

   Yes   No

3. During which Course have you used the Portal?
4. Which functions of the Portal have you been using?
5. Do you find it difficult to use the Portal?
6. Will you use the Portal over the following academic years?

   Yes   No   I don't know   Other

7. Write down the opinions and proposals for working with the Portal!

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