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E-Learning Usage During Chemical Engineering Courses

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1. Introduction

During the last century a lot of changes appeared within the education process. At the beginning of the 20th century, children went to school on foot. Sometimes their homes were very far from their schools, so they spent a lot of time per day just walking. Our grandmothers and grandfathers were such a generation. Sometimes sleepy and tired, they still had to listen very carefully to what the teachers said because they had to make notes for their homework. Teachers were strict and pupils had to obey them. Teachers were often the only people who gave children information about history, geography, mathematics, chemistry etc. Most the inhabitants of those times did not have a radio, and television did not exist yet. Despite this, some of the pupils of this generation went-on to universities and even became scientists. How was it possible? Did they have enough knowledge under such circumstances? They did not have computers and internet yet. In spite of all that, they had knowledge skills, and work ethics than the generations at the end of the 20th century. They spent a lot of time in libraries reading, learning and, writing about what they were learning. They discussed a lot about their problems with their colleagues and professors. They were very good listeners.

In the second half of the 20th century students, in general, did not need to go to school on foot anymore, whether they lived far from school or not. They could choose the bus or train, or even lived in student hostels. The evolution in technology also caused an evolution in the education process. The lectures became more practical. Lecturers did not only use a blackboard and chalk when lecturing but some of them started to use different technical equipment such as overhead projectors and slides for presenting the subject material to their students. Students could spend time in modern libraries, make notes in notebooks or even make copies of the course material. Many lecturers wrote their own books as course material, which students could then buy.

At the beginning of the 21st century, a group of eminent professors of chemical engineering (Felder et al., 2000) announced that in the very near future, it would be almost impossible to carry-out the education process without incorporating better teaching methods. Different study reforms would change the traditional curricula and lecturers would simply have insufficient time for explaining all the material, within the classroom. This meant that students would 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 would be the more important activities regarding a

more efficient education system (Krajnc, 2009). The solutions exist, it is upon the lecturer to decide which method to choose.

When the computer era began, computer experts started to develop information and communication technology (ICT), which created a huge revolution in the presentation of knowledge and information to the world, which then became a much smaller place with a lot more information. A basic ICT infrastructure needs computers, the internet, e-mail, and intranet. Using such structures, an electronic way of learning (e-learning) is possible and in a modern society all these tools are usually available.

E-learning could be used as part of traditional learning (blended-learning, hybrid-learning, mixed-learning) or just as online (virtual) education and incorporated into any course content i.e. the natural sciences or sociology. Maybe it is a little harder to use it in natural sciences because the mathematicians probably asses knowledge electronically less than the historian.

Nowadays, it is normal to use electronic slides, the internet, e-mails, electronic learning environments and e-course material during lectures presentation. When using ICT at lectures, it is the lecturers' responsibilities to present students with qualitative and important information. Many lecturers who use ICT say that when ICT is included within the traditional method of education, it facilitates lectures and the students' work, and the lectures became more dynamic and interesting. Different e-activities also enrich the subject content. E-learning presents an alternative for students and helps them to find a balance between their private lives, careers, and education. It is one of the more dynamic and enriching forms of learning, and reduces dependency on space and time (Paik et al., 2004). It offers both individual learning experiences, and opportunities for working together with colleagues (Peat, 2000).

A lot of statements have been made to date which have shown both positive and negative responses to e-learning. The following are some examples. Lecturers who have one hundred or more students at their lectures know that the lecturer my well spend more time on the final assessment than on lecturing, lecture preparation, and tutorials (Husssman et al.; 2004, Excell, 2004). Because assessment represents a significant part of a lecturer's workload, computer-assisted assessment has the potential for allowing an effective assessment regime to be maintained in the cases of large classes. E-learning assessment of knowledge is also of great benefit from the students' points of view. Rossiter et al. (2010) implemented online quizzes within a Chemical Process Principle Course in the freshman year. Such a new method of learning improved students' learning and success, particularly among weaker students and helped them to develop transferable skills regarding teamwork and communication. The quizzes helped them to do their homework, and to a certain extent, develop their core technical skills for problem-based learning activities.

On the one hand, e-learning brings a lot of advantages whilst, on the other, it does require the adoption of new skills and knowledge. At the beginnings of any e-learning incorporation into the education process, a lot of time is needed in order to learn new aspects regarding the adoption of new technologies, and their different tools. Some users stop using it after their initial experience. Pei-Chen Sun et al. (2008) investigated those critical factors affecting learners' satisfaction with e-learning. They discovered that learner computer-anxiety, instructor-attitude towards e-learning, e-learning course flexibility, e-

learning course quality, perceived usefulness, perceived ease of use and diversity during assessments, are the critical factors. The effect of learning activities and students' satisfaction are influenced by their instructors' attitudes when handling learning activities. Active and positive attitudes do motivate students regarding e-learning usage. Pei-Chen et al. (2008) also discussed that course quality, which includes teaching material, interactive discussion, and course-scheduling, had the strongest association with satisfaction regarding e-learning. Furthermore, many e-learning users were discouraged from e-learning by those poor technologies having slow response-times or frequent technical difficulties.

Nowadays, a lot of e-tools are available for e-education e.g. internet tools (wikis), electronic or virtual learning environments (Blackboard, Webassign, WebCT, Moodle), and web labs. Through such tools the lecturers and students can communicate in two different ways: synchronous and asynchronous. A lot of experiences and supporting technologies on synchronous e-learning were presented by Granda et al. (2010). They pointed-out two major features of synchronous e-learning systems, i.e. audio and video-conferencing. The first one is used to allow participants to participate orally within learning sessions, whilst the second is used to reinforce a sense of user-presence. Floyd Smith et al. (2010) presented their experiences of a synchronous distance-education course for non-scientists, which was successfully carried out over two semesters and jointly by three universities.

Lectures and experts from many institutions worldwide who already use different kinds of e-learning tools within their education processes (Lau, 2005; Maurice, 2006; Selmer 2007; Hussman, 2004; Rodrígues et al., 2006) think that such technology stimulates and motivates students' interest in their subjects, improves their learning performances within the discipline of industrial engineering, and significantly improves the teaching and learning, whilst saving time and money regarding all aspects of the classroom. Web labs, for example, provide students with training for working with experimental equipment and help them to understand the fundamentals of unit operations e.g. distillation and drying (Dongil et al., 2009). Such laboratories drastically reduce the economic necessity of providing new equipment, and stimulate skills such as teamwork, communication, and presentation (Selmer, 2007; Le Roux et al., 2010).

Electronic tools could be successfully used in interdisciplinary learning courses in which e.g. students participate outside the classroom. Schaad et al. (2008) described such course in which students had the option of participating in either a service-learning exercise within an area ravaged by a natural disaster within Lousiana and North Carolina, or to research a topic related to natural disasters. All students attended the lecture component of the course and completed on-line quizzes on Blackboard in order to demonstrate their understanding of the presented material. The twice-weekly lectures were recorded and provided in the form of Webcasts for future reference.

Some educators use Internet tools e.g. wikis technology, to enhance creativity, communication, student interaction, collaboration, and the organization of information (Hadley & Debelak, 2009) when students work on projects, and as a replacement for traditional text-books where students add problems and edit the educational content (Richardson, 2006). When using wikis during projects, the supervisor can keep constant tabs on a student's progress, so the projects are completed on time and the results are valid.

ICT has also been incorporated into some Chemical Engineering Courses at the Faculty of Chemistry and Chemical Engineering (FCCE), University of Maribor (UM), Slovenia. At the

beginning, this novelty confused the majority of the teaching staff. Some lecturers thought that the students' knowledge would decrease by incorporating e-learning into their courses. Only a few enthusiasts believed that new learning methods and tools will produce better and efficient study results, and that some activities will expand both the lecturers' and students' knowledge. The results of their efforts are described in this Chapter.

This Chapter is organized as follows: Section 2 introduces the incorporation of e-learning at the FCCE in Maribor. Section 3 illustrates the efficient tools of e-learning i.e. electronic tests for the e-assessment of knowledge and multimedia e-chapters. The students' and teaching staffs' responses to e-learning are also presented in this section. Section 4 concludes the chapter describing their experiences of e-learning usage from both the students and teaching staffs' points of view, and ends with the challenges for the future.

2. Incorporation of e-learning at FCCE, University of Maribor

E-learning at the Faculty of Chemistry and Chemical Engineering (FCCE) in Maribor was incorporated into the education process for the first time during the academic year 2004/2005. The pedagogical staff started to adopt the electronic learning environment called ELEUM, which was developed at the Faculty of Electrical Engineering and Computer Science, in Maribor. It was available to all members of the University free of charge. It was a simple but effective electronic learning environment, which could be used by all lecturers and students as a communication tool.

ELEUM advanced into the pedagogical process very slowly, because the introduction of anything new is hard and painstaking work. However, the first experiences showed that it could improve the quality of the process. Only one lecturer from one Course used it at the beginning. Only certain activities were used in the first year because this was a new method of learning, teaching and communicating. In general, lecturers put on ELEUM electronic documents of the Course material, the criteria of the Course, dates for exams and colloquiums, and information about lectures, practical work etc. Then new functionalities were added from year to year.

Although the pedagogical staff became acquainted very slowly with this new method of working, the students adopted it almost immediately. Their responses to e-learning and the ELEUM were collected by means of a questionnaire (Krajnc, 2006, 2009). The questionnaires were filled by students at the Process Synthesis Course, where e-learning was introduced for the first time at FCCE. The course was carried-out in the second semester of the third year as a professional higher programme.

The questionnaire results showed that during the academic year 2004/2005 e-learning was almost unknown to students, by the next academic year approximately one half of students knew or partly-knew e-learning, but by the 2006/2007 academic year, all the students knew it well or fairly-well. Thus, information about e-learning within the education process has advanced from year to year (Krajnc, 2009). At the beginning, the lecturer was the main source of initial information about e-learning but over the following academic years, the students received information from their friends and other colleagues who had used an electronic learning environment in previous years, too. Students thought that ELEUM was an effective tool and helped them to improve the qualities and efficiencies of their studies.

They pointed-out the following advantages:

- updated information about the Course,
- all the data collected in one place,
- electronic text-books.

Students also stated, that they could print-out, for example, solution manuals, questions for traditional oral exams, chapters of the text-books, whenever they wanted to. The lecturer could correct the data, and update the manuals and text-books.

In 2009, ELEUM was replaced by Moodle, a internationally-known open-source (course) learning management system also called "Virtual Learning Environment" (VLE) (Dougiamas, 1999). In comparison with ELEUM, Moodle was fairly sophisticated and provided more aids than ELEUM. When Moodle became available for educational purposes, it caused stress among lecturers. It was a novelty once again. For this reason, the lecturers were only capable of putting on it mainly electronic documents and exam results, as at the time of ELEUM's beginning. The Computer Centre of the University of Maribor, Department for e-learning, prepares learning workshops every year because of the problems. By such an education of the pedagogic staff, Moodle has advanced into the pedagogical process from year to year.

3. Efficient tools for e-learning

In spite of many useful electronic tools, being available online, there are some which particularly help to decrease the lecturers' workloads and increase efficiency when studying. The following, presents only two of them i.e. electronic tests (quizzes) for the electronic assessment of knowledge and multimedia e-chapter which helps students to prepare for electronic or classical assessments of knowledge.

3.1 Electronic assessment of knowledge

From almost the beginning of the ELEUM's usage, electronic tests (quizzes) were prepared for students who were willing to choose them instead of the traditional oral exam. Some people would say that creating a bank of questions takes a lot of time and effort, and the final result is a greater lecturer workload. This was true at the beginning of e-assessment but after a year or two the workload decreases because it is unnecessary to create a new bank of questions every year but only to add new or edit old questions. It is certainly true that lecturers engaged in such work have a lot of enthusiasm for their work and want to offer students new ideas.

The students' responses to e-test usage were different in comparison with other available functionalities. In this case, knowledge was assessed using an appropriate mark after finishing each e-test. For these reasons, students did not decide to use them in as greater numbers as for other tools.

The first electronic test was realized at the Process Synthesis Course during the academic year 2004/2005, and since then every following academic year without interruption. Some students have seen a lot of advantages in such a choice, such as (Krajnc, 2008):

- they can avoid the embarrassment of confronting their lecturer face to face,
- they can concentrate better on the questions,
- the results of the e-tests are known immediately.

Since the academic year 2004/2005, more and more students have chosen this assessment of their knowledge, instead of the classical oral examinations (Krajnc, 2008), as shown Fig. 1.

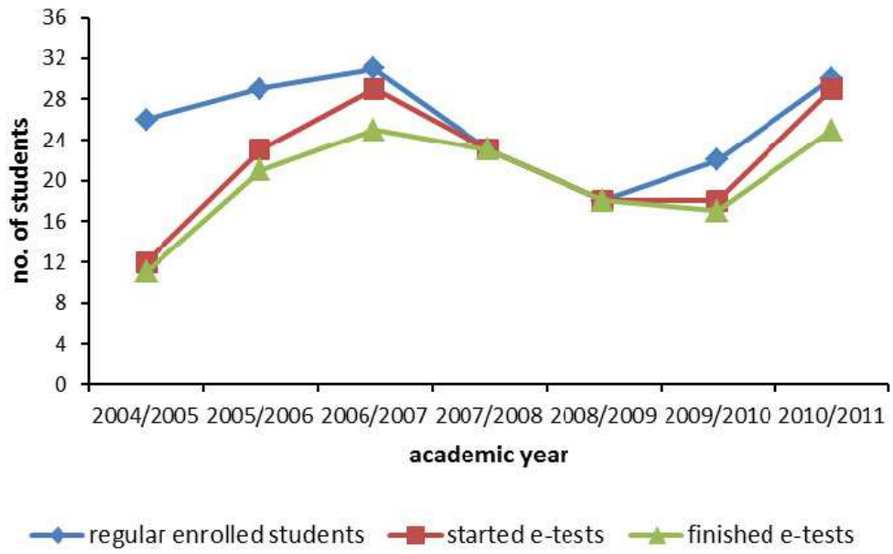


Fig. 1. Students' applications for e-tests during the Process Synthesis Course.

The middle-curve shows the interest for e-tests during the seven academic years of the Process Synthesis Course. The curve shows the increase in e-test applications until the academic year 2007/2008. The next academic year the interest stayed the same, i.e. all students chose e-tests, but in the academic years 2009/2010 and 2010/2011 some students did not choose e-tests instead of the classical oral exam. The lower curve represents the number of students who finished e-tests successfully. It can be seen, that in the academic years 2007/2008 and 2008/2009, all the regular enrolled students chose e-tests and also finished them successfully. It is evident that the number of sceptical students decreased gradually from the academic year 2004/2005 to 2007/2008 but increased again during the academic year 2009/2010. The fluctuation in e-tests applicability among students during the seven year time period was mainly about their ignorance of the new way of learning, and an unwillingness to become acquainted with the knowledge in so short a time i.e. chapter after chapter.

E-tests were prepared for each chapter of the course material separately and were composed of different numbers and kinds of questions. They were executed approximately twice a month. Students had one week to prepare for each e-test. When the e-test was turned on, they came to the Faculty's computer room.

All e-tests included about 70 questions. Students had to focus on each question very carefully since the answers sometimes seemed very similar. A student was successful if the fraction of correct answers was at least 60 %. There were different types of questions in each e-test:

a. questions with one correct answer from two possible answers,
b. questions with one correct answer from among several possible answers,
c. questions with several correct answers from among many possible answers,
d. true/false questions,
e. the essay-type questions.

The following are some examples of those e-test questions included in the electronic assessment of knowledge during the Process Synthesis Course.

Example 1: The essay-type question

A four-component mixture is to be separated by distillation.
The boiling points and amounts of each component are presented in a table.

Component	t_b /°C	q_m /(t/h)
1	-10 (corrosive)	10
2	40 (toxic)	20
3	80	50
4	90	20

What separation sequence would you recommend and
which of the several heuristics explain the orders of separation?

Example 1 represents the essay-type question. The Table presents data for a four-component mixture which should be separated into pure components. Students need to focus on the properties of the components i.e. boiling points, corrosiveness and toxicity, and on this basis determine the appropriate separation sequence. They have to take into consideration two heuristic rules:

a. remove the corrosive and hazardous material early, and
b. difficult separations are best saved for last.

Their findings are written in the box below the question.

Example 2: The multiple-choice type question with one correct answer.

The following result is obtained with the Arrhenius equation:
-E/R = - 19967 K.
The activation energy in kJ/mol is:

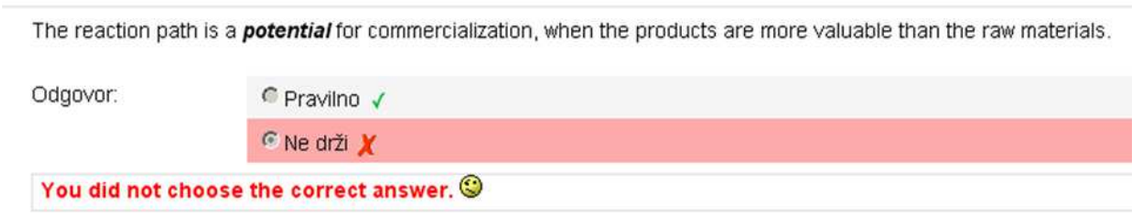
Izberite en odgovor.

- 16,6 kJ/mol ✗ — Your answer is incorrect. You should pay more attention to R constant unit!
- 1660 kJ/mol ✗
- 166 kJ/mol ✓
- 166 000 kJ/mol ✗

Example 2 is more exact because certain calculations need to be done before selecting the correct answer. A student has to know the proper value and unit of ideal gas constant (in this case 8,314 J/(mol · K)) by heart, and then calculate activation energy. He/she must pay attention to the activation energy unit which must be in kJ/mol. When he/she establishes all

the requirements, the correct answer is selected (the third one in this case). Obviously in this case the student chose the wrong answer. The message »*The answer is incorrect. You should pay more attention to R constant unit*!« reminds student as to what mistake he/she has probably made.

Example 3: True/false question.



Example 3 shows a sentence which is written correctly or incorrectly. Students have to read it word by word and very carefully because sometimes only one word has a significant meaning. After deciding the student chooses only one possibility i.e. true (if the sentence is written correctly) or false (if the sentence is written incorrectly). In this case, the student chose the second possibility i.e. false, which was the wrong decision.

Students have the interesting comments on questions with the different kinds of correct and wrong answers. They think that questions with several possible answers are the most pretentious because they have to know the theory in detail. They should focus on answers very carefully because they sometimes seem similar. If they are somewhat unacquainted with the theory of the course, they usually do not select all the correct answers.

Before starting the first e-test, the lecturer explains how e-tests are conducted e.g. that they have time-limits, the questions and answers for each implementation are mixed, how many questions are contained in each e-test, and incorrect answers are estimated with negative points. Students are usually very nervous before the first e-test. This is understandable particularly in those cases where they have not had such a kind of knowledge evaluation up to that moment. In the Process Synthesis Course, the lecturer accepts a failure in one e-test, but they must be successful in the following. The theory of the chapter, in which the student fails, would he/she passes traditional.

The non-traditional way of learning i.e. co-operative work (when doing homework and solving problems in teams) and e-learning, produced good study results during the Process Synthesis Course. Almost all students finished their course obligations within the course time or within one or two weeks after finishing the lectures. The students stated that, in such a manner, more time was left for other courses and obligations where they did not have such work opportunities.

During the academic year 2006/2007, the electronic assessment of knowledge was also incorporated in the second study year within the Process Balances and Process Calculation Courses. During this study year e-tests were prepared for the self-assessment of knowledge before the oral exam. Electronic tests were active from the 1st June until the 1st October of that year, i.e. throughout whole summer examination time. Students who passed all e-tests successfully got an extra bonus towards the final mark of the exam, as a stimulus award. Almost half of the regular enrolled students (46 %) who needed to pass the Process Balances

Course and 33 % in the Process Calculation Course took e-tests before the oral exam (Krajnc, 2009) . They said that:

- with e-tests they learned what was the essence of each chapter,
- e-tests gave them a critique about the knowledge,
- correct answers were available,
- the marks and results of the e-tests were known at once and
- they would suggest such assessment of knowledge for the following generations of students.

3.1.1 Electronic assessment of knowledge for the Bologna study-program courses

When Slovenia in 2004 became a full member of the European Union and the European University Area, the Bologna Process started, to which the members of this area are bound. It encompasses a unique model regarding studies. This has meant reassessing and changing the traditional curricula towards a single-study structure within European Universities (Krajnc, 2009).

The Bologna study programmes at FCCE started during the academic year 2009/2010. Each year the results show that a lot of students register in the first study year, which causes a lot of pedagogic workload for the staff. As the application of IC learning environments is particularly useful when a lot of students are enrolled, Moodle was incorporated within some Bologna Courses i.e. Computer Science in Chemistry Course (CSC), and Process Calculation I Course (PC I) in the first semester, and Process Calculation II Course (PC II), Chemical Calculation II Course (CC II), and Process Balances Course (PB) in the second semester. On the basis of the previous experiences from the Process Synthesis Course, the electronic assessment of knowledge was also incorporated into the mentioned Bologna courses. Lectures at all courses were given once a week (3 hours every week). The lecturer explained the main points of the material, and the students learned the rest by themselves. The following explains the electronic assessment procedures at some courses.

At the Computer Science in Chemistry Course and Process Calculation I Course of the first semester, electronic assessment was introduced to the freshman three times, half an hour before regular lectures, and in a computer room of the Faculty. Each e-test was administrated only once. It was forbidden to write down the questions on the paper. A student was successful if at least 60 % of the answers were correct.

In order to obtain freshman's feedback on the applicability, usefulness, and efficiency of e-assessment, at the end of the semester students filled-in a questionnaire and answered certain questions. It was comprised of 16 questions, 13 of which were multiple-choice type questions and three were essay-type questions. The questionnaire was classified into four parts where students gave their opinions on:

- electronic-learning environment applicability,
- reasons for e-environment usage,
- electronic-assessment and
- the new way of learning.

109 of the students filled-in the questionnaire. The results showed that 10 % of students used the electronic-learning environment Moodle every day, 82 % once a week, and the rest (8 %)

once a month. They also said that the combination of traditional and electronic method of learning suited them and that they also wanted such a kind of work in other courses.

More than 71 % of the students' replies were the same as their older colleagues in the Process Synthesis Course, i.e. that they chose the electronic-assessment of knowledge because they had to become acquainted with smaller portions of the course material at once, the other students (29 %) chose the e-test because they wanted to avoid the oral exam in the professor's office. Three quarters of the students (74 %) said that after the first e-test they could better prepare for the others because after the first one they acquired a feeling for such a kind of examination. Almost all students (94 %) thought that they had enough time to answer all the questions in the e-assessment.

The lecturer also received a significant response about the intelligibilities and difficulties of the questions. The result showed that almost half the students (42 %) thought that the questions were always clear and easy to understand, and 50 % thought they were almost always understandable. 8 % of students replied that questions were sometimes understandable and sometimes not. Furthermore, 79 % of students said that questions were medium-difficult, 13 % thought they were easy, and 8 % that they were tough questions.

In one of the questions, the students compared electronic-assessment with the traditional oral exam. Almost half of the students (46 %) thought that the electronic-assessment of knowledge was easier than the classical one, 45 % said that it was easier and of higher quality, one student said it was of higher quality but difficult, and four students replied that it was easier but of a lesser quality than the classical oral exam. More than half of the students (68 %) felt less stressed at an e-examination as they had to confront the lecturer at a classical oral exam but more than a quarter of the students did not feel psychological burdened themselves by the e-test.

For the essay-type questions students gave their opinions on:

- information about the Course activities through Moodle,
- e-test failure,
- advantages and disadvantages of e-assessing knowledge.

The students mainly said that the information was clear enough, effective, and practical. They wanted to have such information at other courses. The reasons for failures in e-tests were the lack of learning, reluctance at the exam, superficiality, difficult questions, and absence from lectures.

The advantages of the e-examination were:

- on-going learning,
- instant feedback of the results,
- less time to learn,
- you are not under stress.

The disadvantages were:

- ambiguous questions and answers,
- quickly forget the theory,
- no possibility of repeating e-tests,

- reading the question wrongly.

From among the 109 students who started the electronic-assessment of their knowledge at CSC and PC I, 78 students (72 %) finished all e-tests successfully, 19 students (17 %) resigned from electronic-assessment because of negative grades, and 12 students (11 %) resigned from e-assessment because they changed their mind about such a kind of assessment or study, in general. Some students also realised that such a kind of work is too difficult for them.

The analysis of 116 active students i.e. those who finished the experimental computer work in the computer room, after completing the lectures at CSC and PC I, showed that 78 of them completed all the e-tests successfully. The others (38 of the active students or 33 %) had to move to the classical oral exam. The results showed that the lecturers' workloads regarding oral examinations decreased by 67 %. So, what does this mean in hours regarding lecturers' workloads? When you consider that one student needs approximately half an hour for a classical oral examination, 78 students meant 39 less hours needed for oral examinations, which is almost one working week. Within such a time-period, a lecturer could do other things e.g. research work, additional notes regarding course material, prepare new problems for written exams etc. It is also important to point out that the students saved time, too. They did not need extra time at the Faculty for the examination, so they saved time and money on bus or train tickets, or fuel if they had a car.

3.2 The response of the teaching staff to e-learning

Enthusiasm for introducing new methods into the educational process is not as great amongst the teaching staff as with the students. This was already apparent at the time of the ELEUM application. The first responses from the lecturers and assistants were obtained at the end of the academic year 2005/2006, on the basis of a questionnaire which was sent to all teaching staff at the Faculty. The results showed that half of the teaching staff was completely disinterested in e-learning or they were so occupied with other duties that they had no time to answer the questionnaire (Krajnc, 2009). The other half showed resistance to use of electronic-teaching tools within their courses.

Anyway, awareness of electronic-teaching and learning has expanded among the staff from year to year. The more experienced lecturers in e-learning are constantly encouraging colleagues towards the new method of working. The application of different activities within e-learning are presented every year at the "*Slovenian Chemical Days, Conference*" which takes place at the FCCE in Maribor every autumn. The Computer Centre of the UM, Department for e-learning, prepares learning workshops three times a year. Recently, in December 2010, a Workshop on the electronic-teaching environment Moodle's usage was held at FCCE in Maribor. The Workshop was led by a lecturer of the Faculty who has many years experiences in e-learning. The participation of the teaching staff was very low. Only six lecturers and assistants were interested in Moodle application during the pedagogical process. At the end of the Workshop, participants filled-in an electronic questionnaire which included six questions concerning Moodle's application. On the question »*How often do you use Moodle*?« one answered several times a year, two of them replied never, and three of them said once a week. Their knowledge of Moodle was estimated at a 1,7 grade on a five point scale (1-insufficient, 2-sufficient, 3-well, 4-very good, 5-excellent). They said, they used Moodle:

- for informing and sending exam grades,
- for the publication of study materials,
- for questionnaires,
- for displaying a list of students.

On the question »*Do you mean that Moodle facilitates the implementation of work and saves time*?« three of them agreed, one said it does not save time but facilitates the implementation of the pedagogic process, two of them could not agree or disagree with the statement as they had not used Moodle yet. Four participants of the Workshop knew that UM organises educational workshops on Moodle application three times a year but they had not participated in any of them yet. Two participants knew and already participated to them. The answers on the question »*Why don't you use Moodle more often*?« were similar i.e. they did not have enough time for additional education and they did not know enough about the Moodle application.

3.3 Multimedia e-text-books (e-material)

Because at e-learning, students' educations are largely left to them, text-books should be prepared in appropriate forms. Beside electronic learning environments and its tools and activities, which could be used within the learning process, multimedia electronic text-books are useful tools, which additionally implement the education process. A lot of sources and modules can be inserted into such text-books such as: video, animations, internet links, short quizzes with different type of questions etc. In general, learning with multimedia e-materials is more motivated and successful compared with live lessons or other media (video, simulation, and a combination of graph and audio presentations), which enable easier learning. Such material adapts students to various learning styles and facilitates a constructive and enquiry-based approach to learning (Clark & Feldon, 2005; Krnel & Bajd, 2009). When students use multimedia e-text-books, they can better prepare themselves for examinations. Usually, they easily pass e-tests, oral, and written exams and colloquiums.

A quality multimedia e-text-book may only be prepared by the lecturer who teaches the subject. The preparation of an e-text-book is a great challenge, but interesting and responsible work, which takes a lot of time and effort. The lecturer often asks himself/herself what information should be included in e-material. He/she needs to be aware that the content should be clear and concise. Because multimedia e-material may contain animations, quizzes, online links etc., the lecturer should know where and how to enter these tools. His/her skills and knowledge of using them should be comprehensive.

An example of a multimedia e-chapter has already been created for the Process Synthesis Course at the FCCE in Maribor. The chapter is entitled Reaction-path Synthesis and it is an electronic version of the chapter, which is included in the classic text-book, and is usually available to students. The lecturer wanted to know how students will accept this version and what the study results will be achieved. Different types of electronic modules are included within the e-material as: cloze activities, multi-choice type questions, external web-sites, true-false questions, wiki articles, and reading activities. The eXe-learning XHTML editor was used for creating the multimedia e-chapter (New Zealand Government Tertiary Education Commission et al., 2011).

During the academic years 2008/2009, 2009/2010 and 2010/2011, a group of students who had the possibility of using the multimedia e-chapter on the Process Synthesis Course, gave feedback about its usage to the lecturer on the basis of a questionnaire. It consisted of 8 questions, 5 of which were multiple-choice questions, and 3 essay-type questions. The questionnaire was filled-in by 53 students. Among these were also those who had not used the e-chapter. The main reason why they had not used it was that they did not know that such a kind of chapter even existed, because they had not followed the news and instructions on Moodle, regularly.

The results showed that students mainly used both possibilities for learning i.e. the chapter in classical text-book, which is available, and the multimedia electronic chapter (72 %). Of those students who used the multimedia e-chapter, 77 % thought that such a kind of chapter was more appropriate for learning than the classical chapter because it consists of modules for dynamic learning, and 88 % said that they needed less time for studying the chapter material with the e-chapter in comparison with the classical one. More theory was retained in the memory. The same number of students realised that the multimedia e-chapter usage was a good preparation for the electronic-assessment of knowledge.

On the question as to why they did or did not use the multimedia e-chapter, students gave different answers.

One student said: »*The content in the multimedia e-chapter is more transparent and regulated. Learning is more friendly*.«

Another replied: »*It is great because you can check your knowledge*.«

One student thought: »*I prefer the classic way of learning from my notes where I can underline the important things, and annotate the notes*.«

Another replied: »*I like the colour-coded words in the e-chapter*.«

The answer of one student was interesting: »*Such learning is tiring for the eyes. You have to look at the screen continuously*.«

4. Conclusion

Undergraduate-study reforms have placed the student at the centre of the education process. The curricula have been mainly reduced, so that students themselves undertake more responsibilities for better study results. For this reason, the traditional methods of teaching and learning should now be supplemented by non-traditional methods and technologies. These include active and cooperative learning, project work, and e-learning, which help students achieve better results. Students at the FCCE in Maribor, Slovenia now have significant experience with non-traditional learning methods, especially with e-learning. They use electronic-learning environments and e-materials, which enable communication between lecturer-student and the assessment of knowledge. Different kinds of e-tools enable the students to obtain good study results. Since the Chapter focuses on the experiences of e-learning usage from both the students' and pedagogic staffs' points of view, the electronic environments, and their functionalities were not presented in detail. They have already been described in other sources (Krajnc, 2006; Krajnc, 2009).

Students' feedback on the multimedia electronic-chapter of the text-book showed that such a kind of e-material contributes to a better understanding of the subject's content and can better prepare them for electronic and classical examinations. Students who choose the electronic manner for learning usually finish their course obligations within the course time-frame or within one or two weeks after finishing the lectures. For this reason, more time is left for other courses.

Good study results were obtained with on-going electronic-assessment of knowledge, especially at Bologna Courses within the first and second semesters of a study year, when a lot of students are enrolled. It is important that students are not forced into new ways of working because this can lead to stress, but rather allow them to always choose between the traditional way of learning with the text-books.

The pedagogic staff at the FCCE in Maribor already have seven years of experience in e-learning. The results show that the incorporation of electronic-learning environments into education process improves lectures and the quality and efficiency of the study. E-learning leads to a heavier workload for the lecturer at the start, but this reduces over time.

Electronic-learning environments offer a lot of modules and activities that require the continuous enhancement of lecturers' knowledge. Pedagogic staff at the FCCE have the opportunity to enhance their skills through various workshops organised by the UM or the Faculty.

There are challenges for the future. The lecturers who already successfully use e-learning during their courses should encourage other colleagues to use new methods of learning. Sceptic lecturers should know about e-learning implemented lectures to make them more dynamic. The great challenge is to convince lecturers that pedagogic work is also research work like other scientific research. It is recommended that pedagogic staff focus their efforts and time on multimedia e-material production. The faster tempo of life namely shows that, it will be necessary to optimise study time, so the use of quality multimedia e-text-books will be inevitable in the future.

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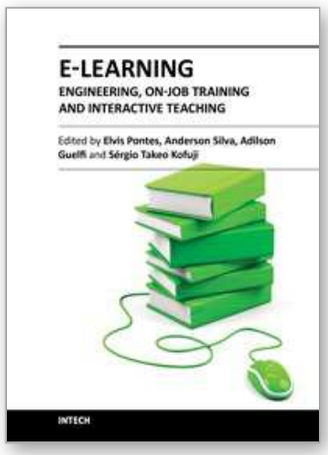

E-Learning - Engineering, On-Job Training and Interactive Teaching

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Adaptive E-learning was proposed to be suitable for students with unique profiles, particular interests, and from different domains of knowledge, so profiles may consider specific goals of the students, as well as different preferences, knowledge level, learning style, rendering psychological profile, and more. Another approach to be taken into account today is the self-directed learning. Unlike the adaptive E-learning, the Self-directed learning is related to independence or autonomy in learning; it is a logical link for readiness for E-learning, where students pace their classes according to their own needs.This book provides information on the On-Job Training and Interactive Teaching for E-learning and is divided into four sections. The first section covers motivations to be considered for E-learning while the second section presents challenges concerning E-learning in areas like Engineering, Medical education and Biological Studies. New approaches to E-learning are introduced in the third section, and the last section describes the implementation of E-learning Environments.

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