

E-learning platforms and quality of engineering education

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INTRODUCTION

The paper results from the author's experience concerning the implementation and usage of various e-learning platforms at the Silesian University of Technology (SUT), Gliwice, Poland. SUT consists of twelve large faculties specializing in all major fields of engineering education, with more than 33 thousand students. Throughout the whole university the e-learning platform based on Moodle software is used, with separate servers dedicated to different faculties, institutes and schools.

The author uses Moodle platform at the Faculty of Automatic Control, Electronics and Computer Science (ACECS FAculty), with respect to courses taught both in Polish and in English language. All students are accustomed to Moodle platform and prepared to communicate with teachers by means of this tool. The most important features of Moodle platform used at SUT are the following:

- communication between students and teachers,
- delivering course materials to students in electronic version,
- organizing quizzes, tests and exams for students by means of e-learning platform.

The last feature – electronic quizzes, tests and exams – proved to be especially useful for enhancing the quality of teaching at SUT. The quizzes system included in Moodle platform is not the perfect one and lacks some important elements including among other flexible grading with negative grades and graphically enhanced answer patterns for multi-choice questions. Nevertheless the system greatly improved the organization of simple and fast tests and exams, especially for larger groups and randomized questions and answers. The possibilities of complex statistical analysis of tests results also greatly enhances the quality of teaching and provides and invaluable feedback to teachers.

The author supervised also several projects that resulted in development of smaller software tools for supporting the organization of studying at SUT [1,2]. One of these tools – so called Electronic Catalogue (EC) system - has been extensively used for the last two years at the Computer Control Group, SUT, for supporting the organization of laboratory exercises and project work. The system is accessible by means of Internet and browser and enables the teacher to track precisely the students' attendance with respect to laboratory exercises, their grades, electronic submission of reports and the teacher's comments to the reports, as well as versatile and flexible communication system. The student has instant and exclusive access to personal grades and several ways of electronic discussion with teacher concerning the duties, reports and grades. One of the most important features of the system is that all grades and other data are stored in the database from where it can be exported to other type of file and serve as a basis for complex comparative analysis focusing on teachers, students and exercises. Such analysis enables working out valuable conclusions concerning the content of different laboratory exercises, quality of introductory materials, the effort necessary to fulfill the teacher's demands and similar, which can be used for improving the quality of teaching in subsequent years. The feedback from students can be also use for precise identifying of possible problems and wasted resources from the point of view of students' education.

E-LEARNING PLATFORM AT THE FACULTY OF AUTOMATIC CONTROL, ELECTRONICS AND COMPUTER SCIENCE

The Silesian University of Technology (SUT) is one of the biggest universities of technology in Poland with more than 33 000 students. SUT was established in 1945 in the highly industrialized part of Poland – Upper Silesia region. The university serves the region and the whole country as centre for higher education and research in almost all fields of technology. SUT is involved in large scale international cooperation in the field of education and research, also by means of participation in the EU-initiated students and teachers mobility programs and through activities of SUT's Regional Contact Point for research programs that is responsible for the whole Upper Silesia region research initiatives.

At present there are twelve faculties in the structure of the Silesian University of Technology, mainly in Gliwice with 2 faculties in Katowice and one in Zabrze. The faculties teaching and research areas are as follows:

- Faculty of Architecture,
- Faculty of Automatic Control, Electronics and Computer Science,
- Faculty of Civil Engineering,
- Faculty of Chemistry,
- Faculty of Electrical Engineering,
- Faculty of Mining and Geology,
- Faculty of Energy and Environmental Engineering,
- Faculty of Mathematics and Physics,
- Faculty of Mechanical Engineering,
- Faculty of Materials Science and Metallurgy,
- Faculty of Organization and Management,
- Faculty of Transport.

Modernization of teaching activities is one of the priorities of SUT's authorities and staff. The main components of the university strategy concerning the teaching process enhancement include the Teaching Effectiveness and Quality Assurance System as well as e-learning and e-supporting platforms usage. The most widely used e-learning system at the Silesian University of Technology as a whole, and at the Faculty of Automatic Control, Electronics and Computer Science in particular, is the Moodle platform based system.

The distance learning platform related activities have been initiated at the Silesian University of Technology rather late – starting from 2001 with respect to the whole university scale and homogenous system. Before several specific concepts of web-based education had been developed and trained, with respect to creating content of lectures to be delivered by means of Internet, building and testing dedicated small systems for Internet-based access to e-lectures and remote laboratories, also as part of international cooperation in the Distance Learning and Minerva components of EU Socrates program.

The work on distance learning platform at SUT was started at the Faculty of Automatic Control, Electronics and Computer Science, Institute of Electronics. The platform is based on Moodle system – modular object-oriented dynamic learning environment, which is well known software package used for assisting teachers in creating high quality online courses for e-learning systems [3]. Moodle system is usually classified as Learning Management System software which means that its basic purpose is to assist teachers and students in Internet-based communication in e-learning framework. Basically Moodle system can be used for creating courses, adding versatile forms of content to courses and help in the organization of several elements of teaching process – including quizzes, exams and surveys. It is very easy to communicate between teachers and students by means of Moodle system, both individually and in groups.

It should be mentioned that Moodle software is a non-proprietary one – it is distributed free under open source licensing. This is important both from the point of view of costs for the university related to the system usage and to the possibilities of extending the system and adopting it to the specific needs of the higher education institution. It is equally important that the system can be used by clients – teachers and students – by means of the general browser only, no special client software is needed, using the system is rather intuitive and easy.

Currently the Moodle based distance learning platform at SUT is used by all 12 faculties, with almost 20 virtual servers and more than 600 online e-learning courses [4,5]. The number of students' users exceeds 12 000 and still increases. It is evident that students become accustomed to the Moodle platform and appreciate the benefits from using it which makes more and more teachers to transfer part of their courses content to the platform. From the students point of view one of the most important things is that they have to login once to the system and they have all their courses with resources available at one place and at once – they do not have to look for course materials at various web pages possibly being asked to login several times, maybe even with different user names and passwords.

The functionality of Moodle platform enables efficient and flexible realization of such tasks as managing users and roles, management of large number of courses, teachers, tutors and instructors management, calendar services, versatile messaging and notification system, efficient and transparent course materials

uploading and maintenance. The system also includes many possibilities of assessment and testing – like various versions of quizzes and assignments.

With respect to quizzes the platform enables to prepare questions from several categories and choose either specific questions for the test or choose questions randomly, including both questions and answers shuffling. The types of questions include such elementary choices as multiple-choice, true/false and numerical, but also calculated type, description, essay and short answer, matching type and random short-answer matching. The assessment and grading is also very flexible, however, some options are clearly missing, including negative components in grades. In general the quizzes/assignments part of the platform is rich in options and the author of this paper used it several times both for organizing short quizzes as part of lecture content understanding test and for organizing final test for classroom exercises components of courses. However, due to some shortages of this Moodle component, especially with respect to previous versions of Moodle, the author initiated project work on even more flexible and better suited for local teachers' needs assessment system.

Similarly there exist nice options in the Moodle software for working with surveys and questionnaires, which is an important part of the education process at universities. Usually the teacher is interested in the perception of his lecture and opinions concerning the content of both classroom and laboratory exercises. Good questionnaire enables the teacher to get much information concerning the effectiveness of teaching and possibly improve some parts of the course. On the other hand the faculty and university authorities are frequently interested in students' opinions with respect to specific courses and other teaching process components and dedicated questionnaire system can be very helpful for this. Again, the questionnaire/survey part of Moodle system in some cases is not flexible enough and the author of the paper was involved in the development of dedicated e-questionnaire system at the Silesian University of Technology.

The Moodle based Distance Education Platform is successfully used at the Faculty of Automatic Control, Electronics and Computer Science and the whole Silesian University of Technology, mainly for providing students with learning materials in electronic form and for communicating with students. However, the weaknesses of the system mainly in the area of grading and documenting the teaching results caused the auxiliary systems to be developed at ACECS Faculty, including the Electronic Catalogue (EC) and Education Results Documenting (ERD) systems described in subsequent sections.

ELECTRONIC CATALOGUE SYSTEM

The Electronic Catalogue (EC) system has been prepared primarily in order to replace the paper catalogue cards used for checking the presence of students at laboratory exercises and – more importantly – for documenting the results of students' work during the exercise and after it – while working on the laboratory report. The paper system has been quite effective but several important drawbacks of it could be also easily seen. First of all the lab part of course typically consists of 10-12 exercises, organized during one study semester. Usually there are two to four teachers involved as tutors with respect to some exercises which means, that catalogue card has to be shared among these teachers. This becomes rather difficult to handle when one teacher is supposed to pass the card to the other and then wants to add something to it. Also, at the end of semester the laboratory manager is supposed to calculate the final grade for each student and in many cases some data needed to do this is missing – mainly because the students still have some work to do with respect to their reports or quizzes. The efficient flow of information in such system is sometimes difficult to achieve and both teachers and students become nervous about delays and inconsistencies.

The other problem concerns the data archiving. Laboratory managers are obliged to archive the results obtained by students while attending the laboratory part of specific course for five years typically. It happens that for various reasons students approach from time to time the laboratory manager and ask for recalling their laboratory exercises grades obtained two-three years ago, e.g. because of necessity to repeat some part of studying. Similarly the laboratory manager can be asked by dean's office representative to produce such data. It is evident that some kind of sure and efficient archiving system with respect to laboratory exercises results could be of great value in such cases.

The EC system seems to solve efficiently all problems mentioned above. First of all this is a multi-user and multi-access system which means that all laboratory exercises tutors have theoretically simultaneous access to the same electronic catalogue card concerning specific laboratory. It is not necessary to pass the card from one teacher to the other, the teacher can input his grades and comments to the system as soon as student get it and such grades and comments are instantaneously available to the laboratory manager. This

makes the work of all laboratory exercises tutors and laboratory manager much easier and faster. The system is also student-friendly in this respect because every student is informed immediately about each grade issued by the teacher, he can also check at any time which grades of him are missing, which reports still await evaluation, is it possible for him to get the final laboratory grade and what grade is it going to be. It is not surprising that the students have become fans of the EC system almost at once and they started to use it extensively. It should be mentioned here that every student is allowed to get information from the EC system only with respect to his grades.

The EC system is also an important tool for efficient archiving of students grades – with respect to their laboratory exercises work, reports contents and laboratory final grades. The system is based on popular database system and all grades, comments and reports are added to the database once issued or uploaded. There is an administration part of the system that is used for intelligent proceeding from one semester to the next one with changing links between students, groups, curricula and courses and archiving the old data. With appropriate backup tools and procedures the EC system enables secure and efficient way of saving laboratory exercises data with possible recall when needed.

As all grades are stored in the EC system database it becomes possible to export it from the system in several possible formats for subsequent analysis of statistical kind. The grades data can be analyzed with either specific course in mind, or specific students and groups of students' results, or with respect to different teachers and laboratory exercises, all data possibly with multi-year horizon. Such analysis is an important tool of data-mining type which can reveal interesting relations among students' grades, courses and teachers.

The reports uploading and evaluation component built into EC also greatly enhances the process of laboratory exercises management. Reports delivered in electronic form and saved by means of Internet accessed database are difficult to be lost or forgotten by the teacher. Moreover, such reports can be properly and transparently filed within the system and archived for possible access in the future and they do not occupy valuable space in the teacher's room. It is easy to verify when exactly the specific report was delivered (uploaded) by the student and in fact the whole process of report uploading and evaluation, including making corrections by the student, can be easily tracked.

EDUCATION RESULTS DOCUMENTING SYSTEM

Electronic Catalogue system is extremely helpful with respect to the organization of laboratory exercises at the Faculty of Automatic Control, Electronics and Computer Science. The Education Results Documenting (ERD) system has been designed for slightly different and broader task concerning computer and network support for communicating and archiving students' grades at the university. The immediate reason for decision to design such system was university wide adoption of European Credit Transfer System (ECTS), which is a popular basis for transferring results of studying between universities in different countries. The system of credits is used not only for transferring results between universities but also for accumulation of credits within one or more universities in order to be promoted to the next study semester/year and finally to get the degree.

Credit transfer and accumulation system implementation caused shifting from giving grades to students with respect to all components of courses towards one cumulative grade for the whole course which may include from one to four components – such as lecture, classroom exercises, laboratory exercises, project work and other. The problems is similar to the one reported above with respect to Electronic Catalogue system but on the higher level. This time there several teachers who deliver lecture, conduct classroom exercises and play the role of laboratory manager for some course and for some group or several groups of students. What we need is precise and fast communication among these people which would allow as a net result for efficient issuing of so called final grade for the whole specific course at the end of semester. Other important tasks of the ERD system include current documenting of students' attendance and performance with respect to course components as well as all data archiving.

One of the most important parts of the ERD system is flexible generation of electronic documenting form for course component and group of students. The structure of lecture or project work documenting may be of various kind and many teachers use their own ways of documenting students' achievements and progress. Whereas it would be impossible to suit all teachers' wishes, the ERD system still tries to deliver as much flexibility of documenting form structure as possible.

The system administrator is responsible for basic students' group composition and assigning groups of students to courses. Then, at the beginning of each semester, every teacher – course component manager –

either chooses the existing one or designs his own electronic documenting form for his component. The form structure includes grades concerning various tasks, quizzes and exams, comments and additional information, as well as numerical coefficients that help in issuing the final grade for the component.

The course manager – usually the lecturer – has another important task to fulfill: he has to either choose or design the special form for calculating the final grade for the whole course, according to the credit transfer and accumulation system implementation. The ERD system again helps the teacher in this task by means of flexible composition of partial inputs paths while computing the final grade, along with numerical coefficients adjustment.

The composition of groups of students is an important and difficult part of ERD system, similarly to the EC system. The ERD administrator is responsible for the most of work, with help from the dean's office. The main problems arise when new groups are formed after the sixth semester, due to the specialization choice by students, and also due to students who are allowed to choose courses from other curricula and year of study – on the basis of dean's office approval. Because of this problems the groups formation and maintenance has to be flexible enough, especially as the whole record of student's grades and group membership should be included in the system database.

Archiving of students' grades is the same important task in ERD system as with respect to EC system, described above. All students' grades with respect to all attended courses and components, together with basic and partial group membership, have to be saved in the ERD system database and archived at the end of each semester for possible use in future. Again, the possibility to archive the full history of each student achievements during study period in the electronic database is an important enhancement when compared with printed records being stored in traditional way.

OTHER SYSTEMS AND INTEGRATION

It should be mentioned that for several years there exist two software system that are used by dean's office staff at the Faculty of Automatic Control, Electronics and Computer Science. The first system – called simply Dean's Office system – has been implemented as rather simple database system for basic enhancement of storing data concerning students at the faculty. The system did not offer many services, it was not generally accessible by means of network and at some time the development of the system was stopped.

The other system developed for the dean's office is so called Study Services System (SSS) which is currently used at some faculties of the Silesian University of Technology, including the Faculty of Automatic Control, Electronics and Computer Science. The system is open and all registered students are able to login to the system by means of Internet. The work on the system implementation was started more than ten years ago and development plan includes almost all aspects of computer and network based support for study organization and e-learning. However, at present the system is mainly used for the new students' recruitment process and for all fees and scholarships related tasks. The system is highly modular and plans to develop new modules for other aspects of computer and network support for studying organization are huge.

On the other hand it is clear from the above analysis that current situation is far from perfect at the ACECS Faculty with respect to the e-learning and e-supporting platforms. It is not possible to use several systems as described above for longer time because it is both uncomfortable and insecure. The Moodle based system seems to be efficient enough as e-learning platform and every year more and more students, teachers and courses are included in its database. New versions of Moodle system are much richer with respect to organizing quizzes of various types, exams, assignments and also surveys and similar feedback oriented activities. Definitely Moodle system is not perfect and first of all it is rather learning management system than web based training one, which would probably cause problems in near future when more sophisticated tools concerning part of higher education process being delivered by means of – broadly speaking – Internet will be a must.

The second part of desired functionality of e-learning/e-supporting systems concerns topics as students recruitment, maintenance of students' accounts at dean's office, Internet based attendance checking, grades and comments storing, curricula management, teaching/learning activities scheduling and teaching resources management. It seems that the SSS system mentioned above will be developed in future in order to include modules responsible for the mentioned tasks. Unfortunately the SSS system is already quite large and complicated and making changes in its functionality has to be done with large care, especially as it is important for current operation of dean's office. It is also obvious that smaller systems – like EC or ERD

ones described in this paper – can be more flexible and easier to use by the majority of teachers and students. This is a very important factor because the success of such systems usually comes from people who want to use it because they see that the system is easy to master and enables them to perform some routine tasks faster and better.

It would be therefore desirable to implement and use systems like EC and ERD in order to enhance the quality of teaching organization at the ACECS Faculty and to gain experience with respect to possible drawbacks and missing features. Such experience should be used while building modules that could be integrated with SSS system, in order to achieve working system with tested features and interface, to which both teachers and students are accustomed and can use it efficiently. One of the more important task should be the possibility of transferring archived data from the EC/ERD systems to the SSS modules in order to be able to easily get access to grades, comments, reports and other past data in the final version of the system.

CONCLUSIONS

In the paper the examples of using at the Faculty of Automatic Control, Electronics and Computer Science, Silesian University of Technology, Gliwice, Poland, several e-learning and e-supporting platforms and systems were described and analyzed, especially from the point of view of enhancing the quality of engineering education at universities.

The systems used at ACECS Faculty and whole SUT should be merged in near future to one-stop-shop like system for students – with one entry point and one login procedure as well as with excellently structured interface for accessing the rich e-learning and e-supporting oriented services of the system.

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