# Example of LMS based assessment in engineering education

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## Abstract

The paper concerns the methods used for assessing students by means of innovative schemes including Learning Management and Support systems – including Moodle platform - as well as dedicated procedures aiming at efficient and fair LMS based assessment scheme. Results presented in the paper have been obtained while teaching courses in internet technologies and computer networks in large ICT and Electrical Engineering oriented faculty at Silesian University of Technology, Poland. The group of students taking part in the LMS based assessment experiments included both domestic students as well as in some international students' exchange participants. The author included the new assessment schemes as part of the mentioned courses with respect to the last three years, with several modifications having been implemented due to the assessment results – comparative study of these modifications and their justification is discussed in the paper. The author complemented the available LMS system assessment possibilities with options developed in the dedicated learning support system in order to get more objective results.

## Introduction

In the paper the examples of using e-assessment of students by means of Learning Management and Support system – Moodle platform – are reported. The tests and quizzes mentioned below in the paper were prepared for students of large automatic control, electronics and computer science faculty. Electronic assessment was tested on group of both Polish students as well as international students groups resulting from European students exchange schemes. The paper includes conclusions resulting from using the described e-assessment scheme for three years with substantial adaptation of methods and test content.

### Basis for electronic support for teaching at Silesian University of Technology

The Silesian University of Technology (SUT) is one of the biggest universities of technology in Poland with more than 30 000 students nowadays (about 33 000 students a few years ago). The university was moved to Gliwice in 1945, as a result of borders changes in Europe. From that time SUT operates in one of the most highly industrialized parts of Europe – Upper Silesia region. The university is recognized as Silesia region centre for higher education and research in almost all fields of technology. SUT is involved in major 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.

Nowadays the structure of the university includes twelve faculties covering all major areas of technology and management. The main campus with nine faculties is in Gliwice, two faculties are in Katowice – 30 km away from Gliwice - and one in Zabrze, 10 km from Gliwice. The faculties teaching and research areas include Architecture, Automatic Control, Electronics and Computer Science, Civil Engineering, Chemistry, Electrical Engineering, Mining and Geology, Energy and Environmental Engineering, Mathematics and Physics, Mechanical Engineering, Materials Science and Metallurgy, Organization and Management, as well as Transport.

Modernization of teaching activities is one of the highest priorities of Silesian University of Technology. 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 (ACECS) in particular, is the Moodle platform based system.

The distance learning platform related activities have been initiated at the Silesian University of Technology in 2001

[2] and it covers the whole university – all faculties and supporting units. Several specialized concepts of web-based education have been also 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 additional web-based education components accompany nicely main modules present in the Moodle platform.

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. Typical use of Moodle system includes 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 [3]. 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.

# Example of LMS based assessment at ACECS, SUT

The author is involved in teaching several e-assisted courses at ACECS, Silesian University of Technology [1], among other course on internet technologies for all automation and robotics majors, adaptive techniques in control course for computer control systems MSc specialization, as well as computer networks course for domestic and foreign students as part of so called international Macrocourse studies. With respect to all three courses mentioned above there is a lot of computer usage during teaching and tutor assisted laboratory work and therefore courses are well prepared for incorporating elements of e-assessment.

With respect to all courses mentioned above it is customary to organize about two tests during one teaching semester in order to get the feedback concerning the teaching efficiency as well as to get partial grades for building overall course grades. No introductory tests are performed, with respect to adaptive techniques in control and computer network courses there are final tests – exams – organized.

Traditionally final tests – exams – are organized in "standard" form with respect to the majority of courses, i.e. using pen & paper. Usually there are several teachers involved in preparing and running such tests and reviewing the students' work and grading needs a lot of work. In order to reduce the workload during the semester – with respect to in-semester tests – the e-support is of great value.

There are typically 130 students attending the internet technologies course every year, about 90 international students attending the computer networks course and about 30 students participating in adaptive control lectures and laboratory exercises. Reviewing that number of tests twice a semester by one or two teachers means really a lot of work. This was the primary reason for starting the e-assessment in the form of LMS Moodle platform based tests/quizzes some years ago at ACECS. It is obvious that in such case the teacher has to face a lot of other kind of work: preparing special questions/tests that fit to the e-assessment specific features, maintain the questions, use advanced methods for composing tests from questions repositories and automatic grades calculation. All this has to be taken into account when comparing both ways of assessing students but even then the time saving is evident.

There are of course additional assets of using e-assessment at university apart from the ones mentioned above. First, the tests can be composed individually, it is possible to generate separate sets of questions for each students – from the large and versatile repositories of questions. It is also possible to generate different set of numerical parameters for each student with respect to some kind of questions which usually needs an additional and nontrivial work on automatic calculation of correct result for randomly chosen parameter values. It is of course possible to design the test individually for each student – on the basis of previous results and grades, it is advantageous to run the tests in adaptive mode – trying not only to assess the student but also to use tests for maximizing the teaching efficiency.

It is relatively easy to use computer lab for running such test for group of 30 students and this was the case of adaptive techniques in control course. The test questions include both short calculation oriented tasks that end in numerical result, as well as open questions that can be used for testing the level of course topics understanding among students. Similarly it is possible to use computer lab for running e-tests for computer networks course students that usually work in three 30-people groups. With respect to this course there are more questions of single and multiple choice kind, there are still some open questions/problems and the ones involving the calculation of numerical result. The results of using e-assessment for both courses mentioned above were very good, the students liked the tests, the LMS Moodle platform appeared to be well prepared for running such tests, also the teachers appreciated the possibilities of reusing questions, individual test composition, no problems with cheating and fast grading.

More problems appeared with respect to running the e-assessment tests for internet technologies course and large group of about 130 students. It was not possible to divide the group into parts and running the test for such large group in computer lab at the same time was not possible. Therefore it was decided to assign time slot for performing the test out of the standard teaching hours and to let the students work on the test without supervision. Of course in such case there is high risk of "group work" and other ways of violating the test rules and in general the results

of such tests are much more difficult to be trusted. The test in the mentioned form has been organized for internet technologies course participants for the third time in 2008/2009 academic year and of course some adaptation took place in the test form. Of course students have to use their personal LMS system accounts which gives some basic element of security. The time slot for the test is rather short. The questions are in majority of multiple choice type with adapted penalties corresponding to wrong answers. There is also rather large excess of questions and of course test questions are chosen randomly in groups, with both questions and answers being shuffled. As a result it turned out that it was possible to run e-tests even for this large groups and again, both students and teachers liked the scheme and were sure about its usefulness. Definitely in the last case – large group and unsupervised test run – it is worth to compare test results with other data, e.g., with grades obtained from laboratory exercises or project work – results of such comparative analysis revealed that credibility of test results was high and justified the decision to use this form of students' work assessment.

## Conclusions

In the paper examples of using internet infrastructure and tools for organizing e-assessment for students were reported. The tools include Moodle platform as an example of Learning Management and Support system and tests and quizzes as form of assessing students. Results concern both supervised and unsupervised testing, either synchronously in computer lab or asynchronously in specified time slots. The courses tested included both theoretically oriented courses on control systems as well as software and technology oriented courses on computer networks and internet technologies. The target groups included both domestic and international students, from 30 to 130 people. The questionnaire based analysis proved the popularity and efficiency of mentioned tools and methods both among students and teachers. It is advantageous to complement the typical LMS system assessment possibilities with options developed in the dedicated learning support system in order to get more objective results.

## Acknowledgements

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