

E-learning implementation in superior technical educational system

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Abstract. E-learning methods apply to most modern and various domains but also represent a great tool for the mechanical educational system where there are a lot of sustained efforts for its implementation. Using, administrating and maintaining an e-learning system for a certain field of study requires knowledge related to computation system's utilization but also the understanding the working mechanisms behind it that allows the system to be fully customized in order to be perfect fitted to the user's needs and requirements. A Moodle based test is evaluated from several points of views such as coherence clarity, concise content, information synthesis capacity and the presentation mode which makes the difference between clear or fuzzy graphical representations or terms. The authors appreciate that the ability of managing information in real time by the professor is a decisive decision in order to successfully implement an e-learning web platform. Updating information and structuring trainee's activities from thoroughgoing study up to their individual proposals for conceived applications leads to a better understanding and practical knowledge of theory.

Keyword: e-learning, engineering education, Moodle, analysis of activities.

1. Introduction.

Training students in mechanical engineering and a continuous formation for specialists from the industrial environment requires multiple sustained efforts from both the trainers and the trainees. The actual performances of CAD, CAM, CAE, PDM and PLM software impose a continuous adaptation to new requirements needed by the engineered product's quality and performance. That is why we appreciate that e-learning systems represent a modern solution that answers to few of the current issues.

Keeping in mind that project management represents a tedious and very intricate activity that requires people with good knowledge and skills we consider that training them has to be done in the most complete and comprehensive way possible. In order to assess the benefits of collaborative teamwork performed for project development and engineering design we need to first train our students and get them familiar with



collaborative learning procedures. We think about the learning curve as a sum of various instruments used in the process. That is why traditional learning such as paper based courses and basic lab experiments or seminars are considered somehow obsolete but may be better acknowledged as part of the whole system. Nowadays students interact online far more quickly than anyone could have ever imagine a few decades ago and look for their information from various sources some more reliable than others. That is why we do refer to above mentioned traditional forms of education as to passive education whereas the online environment is considered the true active part of the system. That being said, not all the online content is adequate and appropriate to be used in educational purposes. Today efforts are more focused whether to better understand the factors which affect the quality of engineering education. Different educational systems struggle to understand changes brought by the web and try to fit them in their programs as complementary. The authors feel that there lies the problem because the online content and the means to access it should represent the first priority that everything else revolves on. That would lead inevitably to excellence in education and efficiency because of the much more object related structure of courses and training materials available online. The goal of every educational system is to prepare the student for a career. That being said we cannot ignore the true benefits of web content being delivered anywhere at any time. Real life examples, debates, quizzes and forum topics are very powerful instruments that students may attend in the learning process which researches have shown to bring more effectiveness, interest and competitiveness among students. They feel that being constantly pushed to solve problems, having granted access to meaningful and reliable up to date information helps them to quickly understand the mechanisms and be aware of the issues that may appear in the process. Thus, students may gain knowledge in engineering design, processing and manufacturing. That is why the authors consider that in addition to traditional courses, CAD, CAM, PLM training is a must.

2. E-learning system application in engineering education.

In Romania and abroad there are many e-learning systems known approaches. One of them, nationally implemented is the one from the Polytechnic University of Bucharest [12] whose functions among others for skill improvement of engineer professors from pre university technical educational system and as a benchmark of the project's success its participant's results [2] were considered as reference in the management of resources related to mechanical computer assisted design. Targeting the development of several tools used in sheet metal processing the authors developed a collaborative system [7] which involved teams from different universities. The paper [7] presents the team efforts of the CAD/CAM/PLM laboratory of Machine Manufacturing Technology department for collaborative development in case of several industrial projects. The project development has been achieved due to collaboration between mechanical student's team, researchers and engineers from manufacturing based enterprises. Because the level of competences was different for every team involved that problem meant that training sessions were necessary in order to get team members to be familiar with CAD/CAM software and PLM related technical data administration. The teams have developed and sustained a series of working modules based mainly on the documentation they had at their disposal as well as the one found online. Software specific tools and tutorials were frequently accessed and it allowed the project to grow. A step forwards was made by designing the system's database in MySQL as well as its interface in PHP language [7]. The decision was in favor of multiple working modules because past experiences shown that module based testing systems are more efficient because they provide convergence of training processes allowing main issues to be clearly highlighted within tests that being the very foundation of testing to begin with. The project expanded on several branches and directions and it also included quizzes, clearness and efficient content management for ease of training, problem identification and solving, on place verifications and evaluation for the evolution and the degree of understanding during training sessions, adaptability and dynamicity. Of course the authors appreciate that there is room for improvement constantly trying to fine tune and make all the necessary

adjustments in such a way that quizzes may be more objective orientated inside trainings and in such a way that they could be easily adapted to every team's specific needs and degree of knowledge and professional experience. The need for adaption arises when members of even the same team started to respond differently to the same training content thus making it clearly that the questionnaires have to be addressed to certain aspects individually. Experience showed that question formulation had to be different for every team due to their degree of understanding, knowledge, and experience and implication level. The team of researchers was the most involved ones being very capable and responsive. It also had been the team which learned the quickest. The student team was very receptive but it lacked experience and professional knowledge thus making it the one which had less questions and for that matter, debates regarding discussed matters within the project. That being said it is very much alike with what Moodle proposes and succeeds by its implementation in technical superior education systems. Moodle widely implemented as a management system knows new utilization domains but also new means of connection such as PC's networks, cloud systems, mobile OS's as well as other. Its adaptability and scalability to those environments as well as its property as open sourced software make it so appealing [1], [11]. It can provide maximum output when correctly configured and may lead to rapid development and improved knowledge of the trainees those being key ingredients for their competitiveness on an ever changing and dynamic professional market [9], [12].

E-learning methods apply to most modern and various domains but also represent a great tool for the mechanical educational system where there are a lot of sustained efforts for its implementation. A very interesting direction is that of the m-learning platforms which are complementary to e-learning ones in terms of future development of engineering teaching methods or measurements dissemination [3]. As an immediate application Moodle may be used as a comparison form between results that were obtained traditionally in the field of science of materials with the ones obtained by e-learning methods for graduate students starting with their first year of study [4].

Another interesting application is that of a distance based educational system through e-learning dedicated to technical universities students or to economical profiled universities, or to the employees of a company such as production focused companies that are interested and have the capability to implement such a system on their intranet or it may be addressed to technical and economic data management systems MRP/ERP [8].

3. Considerations over a Moodle based system for training in design and manufacturing in mechanical engineering.

Using, administrating and maintaining an e-learning system for a certain field of study requires knowledge related to computation system's utilization but also the understanding the working mechanisms behind it that allows the system to be fully customized in order to be perfect fitted to the user's needs and requirements.

The transformation process involved in turning a traditionally presented course into one that uses an e-learning system requires total implication, dedication and a considerable amount of work for it to provide maximum output in optimal conditions [5]. Professors tend to divide the evaluation process of a certain learning system into technological, pedagogical and organizational components. This division on components does not exclude an internal analysis as well as the functioning product's quality.

An evaluation process of an online based learning system performed professionally will take into account as an expert analysis the one that considers multi criteria of evaluation for the analyzed software components which grade the highest in their utility domains for which they have been designed. For example a Moodle test will be evaluated from several points of views such as coherence clarity, concise content, information synthesis capacity and the presentation mode which makes the difference between clear or fuzzy graphical representations or terms. However the test will not be assessed from the student grades point of view because

this is not a defining feature in the evaluation process of the software's capability but is more about the professor's capability to order the information and present it properly.

4. Moodle system assessment



Figure 1. General view over the e-learning system CAD/CAM/PLM orientated with details about course studies that it contains.

Keeping in mind the above presented reasons and benefits, the Machine Manufacturing Technology Department from the Technical University of Iasi has implemented inside the CAD/CAM/PLM laboratory an e-learning educational system based on Moodle (v.2.6) as shown in figure 1. The first variant has been developed and used back in 2013 and at the present time the platform contains 7 courses studies and has been used by more than 650 students from both graduate and master studies. Even though subjects are related each course study is original because the authors have adapted them to trainee's specific activities and knowledge. The available resources for students contain manuals elaborated by the authors, tutorials and product documentation for each software solution used in the laboratory (Solid Edge, NX CAM, ESPRIT, and CIMCO), scientific articles and links to relevant content website.

In order to appreciate the quality of student knowledge a special attention was given to the dynamic development of trainee's activity area. Continuous evaluation of the trainee for the given course time of 14 weeks is carried out by:

- The completion of practical sessions highlighted by the student's personal reports,
- The completion of a number of 3 or 4 simple tests, multiple answers tests or essay like tests that contain questions from the main topics of the presented course,

- Solving two home works (mini projects) having topics about designing technologies for the machining on CNC driven lathes and milling machines, proposed machining processes simulation and development of the specific G code,

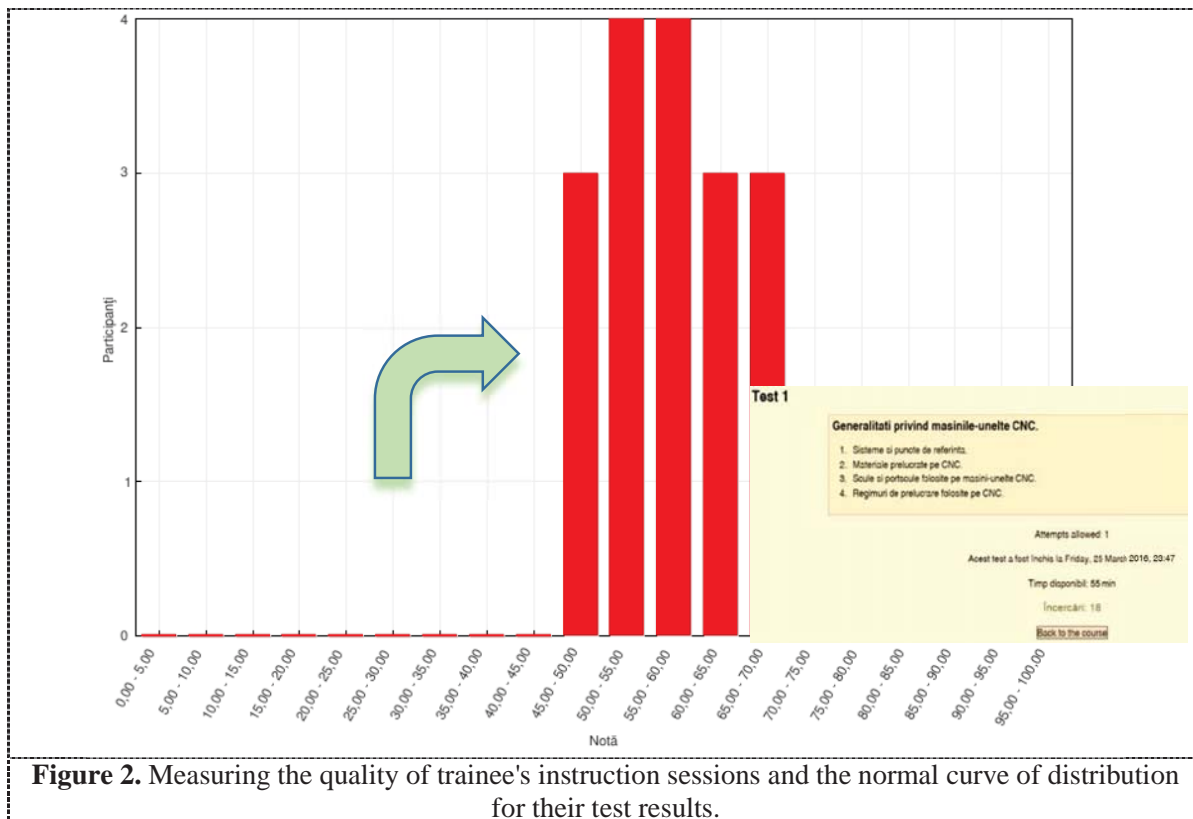


Figure 2. Measuring the quality of trainee's instruction sessions and the normal curve of distribution for their test results.

- Participation in forums through interventions on specially proposed themes by the course leading professor.

For assessing the correctness of testing activities the following Moodle features have been used:

- The elaboration of questions having the same subject but in a differently presented form (one or two occurrences at almost 50 questions per test),
- Random occurrences of question order for each student,
- Random occurrences of answer order for the same question,
- Verification of grades distribution normal curve (figure 2 illustrates grade repartition for one class of registered users).

5. Conclusions.

Analyzing statements from the same profile literature it results that the management of learning systems knows new application domains and different approaching directions. Using cloud systems, specialized networks, smart phones or tablets is a very actual and daily habit of the common user and thus it represents the future perspective of every e-learning system.

Considering the performances of new intercommunication technologies e-learning systems will become more attractive as they will encapsulate up to date information addressed to every type of student in

particular dependent on its profile and its interface and presentation form will be more intuitive and adjustable to any screen or OS environment.

The authors appreciate that the ability of managing information in real time by the professor is a decisive decision in order to successfully implement an e-learning web platform. Updating information and structuring trainee's activities from thoroughgoing study up to their individual proposals for conceived applications leads to a better understanding and practical knowledge of theory.

In the case of computer assisted design classes as well as assisted manufacturing there are requirements for applications which will ensure a strong knowledge of CNC machines, tooling and their tool holders, manufacturing materials characteristics and those of machining regimes. There are also a need for CNC machine programming languages knowledge as well as for used CAM software in order to be able to simulate the manufacturing processes and thus to generate specific NC machining operations in G code accepted language.

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