

CHALLENGES AND STRATEGIES IN THE FIELD OF ENERGY AND PROCESS ENGINEERING IN THE ERA OF DIGITAL TRANSFORMATION

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Abstract: Era of digital transformation lead to the changes in different areas of human life. This influence has also being noticed in the education sphere. At the Department for Energy and Process Engineering, Faculty of Technical Sciences in Novi Sad we are striving to a critical following and carefully estimation of implementation of the chosen trends involving also application of ICT resources in order to enable definition of the strategies according to them and achievement of continual and long-term sustainable development of the Department. In this paper is given an overview of the challenges and forming of possible strategies for further development with the help of modern ICT solutions. The available educational tools which could be used as a complement of existing resources in some of the aspects. It is given an overview of existing possibilities and the ways of providing of digitalized teaching forms, their advantages, as well as potential problems. Such approach could be helpful for solving some of the problems relating to a common studying way, such as enabling of following the teaching to the employed students or to the students who are because of some other limitations are not able to be physically present in the classroom. Of course, in the case of application a number of issues is rised because of some, until then unknown problems in terms of incompatibility and non-acceptance of the students and maybe even more of the staff who should be able to enable these processes, non-recognition of such studying ways in all legal acts by which should be regulated details relating to operation of educational institutions, gains or the problems in the case of application, etc. Existing possibilities are observed in the light of possible applications in the field of Energy and process engineering.

Key Words: Digital Transformation/Educational and Research Infrastructure/Energy and Process Engineering

1. TEACHING AND RESEARCH INFRASTRUCTURE: CHALLENGES AND STRATEGIES

Department for Energy and Process Engineering strives to further develop teaching and research infrastructures in order to introduce new working methods, expanding the field of practical research and raising the quality of work. The Department has Laboratory for energy and process analyses, which are aimed to computer modeling, developing of specific simulation and optimization analyses, processing of data or measurement results, etc. Equipped with IT tools, this lab enables the integration of existing measurement-acquisition equipment with modern software tools. Such infrastructure significantly improves research approaches and extends capabilities for analyses of energy and process related problems. Despite mentioned practice, Department faces with complex and numerous methodological challenges. In order to overcome them, Department considers ICT technologies to support strategy how to:

- Eliminate the existing fragmentation of research capacities,
- Focus the researchers more towards innovations, technical solutions and applied researches,
- Ensure strict commitment to quality standards in research procedures,
- Consolidate education topics and research activities,
- Encourage international cooperation and academic networking.

For supporting mentioned strategy, innovative emerging technologies have to be introduced in order to improve capacity of educational infrastructures. This would significantly enrich existing research approaches and expand possibilities for advanced analyzes of the various thermal and process problems.

The growth of the knowledge society and the development and extensiveness of the emerging ICT technologies represent a major challenge and a major opportunity for education [1]. Over the past decade, many high education institutions have made large investments in improving their educational infrastructure by high performance computers and powerful software tools and applications. However, providing computers or access to software tools alone does not automatically increase educational quality and learning effectiveness. For overcoming mentioned challenges and use of ICT opportunity, Department creates complementary measures and strategies [2] such as:

1. Adapting teaching approach. Traditional approach need to be redesigned to allow a more efficient integration of emerging ICT technologies. Students should be taught not only how to use ICT products but also how to use

ICT as tools to assist them to learn and think independently and to develop interests to search for deeper interpretation of engineering information.

2. Develop qualified teachers. Building competences of teachers is necessary to provide intelligent use of ICT resources and to open integration of new methods into their work, to redesign curricula and integrate qualitative and interactive techniques into traditional paper-based studying or research.

2. DIGITALIZATION WAYS OF TEACHING

There are some possibilities of complementing of the existing educational methods by the approaches based on different ICT solutions. Such is recognized by Law of higher education [3] as a "distance learning" in Article 96: "Higher educational institution is obliged to organize the lectures and other forms of studies for all students, except in case of distance learning organization".

Distance learning or better learning by the help of a range of ICT solutions may be made according to more different criteria. Some of them are shown and analyzed in this paper. We tried to take into account finished tools/platforms, since the application should be implemented by the staff not necessarily specialized with programming skills. Hence, the more detailed analysis of programming tools in these purposes is omitted.

There are more different educational platforms in the existing institutions (so called LMS-Learning Management Systems). Among them, probably one of the most popular is Moodle [4] for which is at Faculty of Technical Sciences already developed e-lib (eLLab [5]). This option enables implementation of existing courses through the tools which might be fully adapted to a targeted group of the enrolled students. There are also some other LMSs, less popular, such as: CourseSites by Blackboard, Sakai 11, ILIAS. There is also ELMSLN LMS system which represents an extension of Drupal open-source content management system. Enlisted LMS systems are built on the base of Java or PHP (Dokeos). Most of them is cloud-based, although there are some of them available after download only (Dokeos).

There are also LMS systems not specialized for educational institutions, but for the training at the level of corporate trainings and B2B environments available on commercial bases (e.g. LatitudeLearning). Scoology LMS is free in the basic package for the instructors, but it has an upgrading option to Enterprise package in the case of specialized support or integration with student information system. There are also LMS systems based on WordPress (or they are simply its plugins, such as Academy of Mine with a cost starting from 199\$ monthly). Some them are: LearnDash LMS (129-299\$ for unlimited site licence numbers for paying only once), Sensei which costs for a site 129\$ and WP Courseware which costs 99\$ for 2 site licences. Beside commercial it is possible to find also free or partially free levels of LMS such as LifterLMS, Namaste! LMS or LearnPress LMS (which basic plugin is free, but premium versions, such as certification option cost in the range 20-30\$) which are mainly financed through commercial upgrade payment offering something more than the basic package. Beside these, mainly plugins, there is also WPLMS which is actually a WordPress theme. There is also plugin for connecting Moodle and WordPress. In the field of LMS entered also some of IT industry giants (Google Classroom), which only points to the estimated importance of this educational development trend direction.

Some of the biggest world universities (MIT) developed their own platforms (MITOPENCOURSEWARE) [6] and the courses put on them, beside they are free and „they are not replacement for enrolment leading to graduation degrees“ they have the promotional role and attraction of the worldwide located students. Beside such approach, during the past couple of years a lot of platforms with so called MOOC - *Massive Open Online Courses* appeared. Among them (based on the criteria of cost forming) there are several categories; completely free and financed through a not compulsory donations; those payed by those wishing to be certificated, and free for those only wishing to finish them and/or pass the material, and fully commercialized courses.

Some of MOOCs are specialized for specific fields: programming (box-hill-institute, cybrary, eduonix, leada, mongoddb, openhpi, opensap, opensecuritytraining, oracle-learning-library, simpliv, stepik), geosciences (esri), educational issues (european-schoolnet-academy, open-education, schooleducationgateway), economy and finance (mruniversity, philanthropy-university, smartly), project management (projectmanagers-org), psychology (virtual-euniversity). Among them there are platforms with different engineering courses (Alison, Coursera) with some courses related to Energy and Process Engineering fields. Beside MOOCs mainly or exclusively available in English, there are some of them where the most of the courses is presented in some other languages: French (fun, unow), Italian (federica-web-learning), Spanish (miriada-x, uned-abierta, upvx, urjcx, unimooc-tec), Portuguese (telelab, veduca), Russian (younico).

Use of MOOC is recognized and even further evolved into some of the existing financing programs of the developing projects [7], where some of the supporting training courses »to the MOOC leaders for development of the component for virtual exchange which could be added to their programs«. Virtual exchanges present some kind of online dialogues which are usually supported as part of informal or even formal educational programs and which are in this way able to be conducted regardless to geographical location. In such way is, as the promoters of these programs specify, is enabled logging into safe video-conferencing platform and discussion under supervision of trained trainers about the topics of interest with more engagement of the participants, their »active listening, following and critical thinking«. Some thoughts are also made that by the use of such tools are improved

employment skills, since they demand »effective communication, practicing of other languages and cooperation regardless the difference«.

Some of the institutions in the field of higher education are also developed unformed courses in which are explained some of the phenomena from the field of natural sciences and engineering [8] freely available for watching, download and in some cases for calculations, with offered possibility of donating in order to make it self-sustainable, which is also a principle used by some of the biggest institutions [6]. Beside thes, individual users (even some of them not employed in formal educational systems) use different networking tools and social networks for organization and providing access to educational materials (youtube, LinkedIn, Facebook etc.). It should not be ignored also platforms/applications (apps) developed exclusively for smartphones and often freely available, but with adds included. Of course, beside apps there also exist developed platforms for different fields (e.g. SoloLearn for programming or Android version of Coursera etc.).

It is a serious issue of criteria definition based on which will be made decisions for use of some other of the enlisted tools, as well as opportunity of quality rating of the achieved results and comparison with realized contribution by classical approach. What is necessary, after resolution of initial problems or even before selection of appropriate platform/tool is existance of quality evaluation systems of the outputs and estimations of intuitiveness of the tools or the necessity for staff training. There are also issues of motivation, availability, resistance and other human characteristics directed to the use of these tools or their combinations.

3. CONCLUSION

Use of different ICT based platforms should be carefully analyzed and even more carefully implemented in order to add some positive value to an educational system. The development of the Department of Energy and Process Engineering, Faculty of Technical Sciences, goes in the direction which should resulted in the engineers and researchers more focused towards innovations, technical solutions and applied researches at the same time ensuring strict commitment to quality standards in educational and research procedures. Everything helping development in this directions is welcomed, including different aspects of modern educational tools.

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