

FRI-K1-1-QHE-15

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**QUALITY OF DISTANCE LEARNING IN ENGINEERING**

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**Abstract:** *The paper reviews existing methods of distance learning which are applied in modern higher education and are supported by international standards for quality. Different forms of distance learning are presented and compared against each other. The advantages and disadvantages of e-learning, m-learning, and online tutorials are discussed. The ideas of the authors are supported by several examples of distance learning. Recommendations for the application of distance learning methods in engineering laboratory courses are made.*

**Keywords:** *Distance Learning, E-Learning, M-Learning, Online Tutorials.*

**JEL Codes:** *I23, L15*

## INTRODUCTION

Distance learning (DL) can expand access to education and training for both general population and businesses since its flexible scheduling structure lessens the effects of the many time-constraints imposed by personal responsibilities and commitments. Furthermore, there is the potential for increased access to more experts in the field and to other students from diverse geographical, social, cultural, economic, and experiential backgrounds. As the population at large becomes more involved in lifelong learning beyond the normal schooling age, institutions can benefit financially, and adult learning business courses may be particularly lucrative. Distance education programs can act as a catalyst for institutional innovation and are at least as effective as face-to-face learning programs, especially if the instructor is knowledgeable and skilled in ICT. This paper aims to formulate the ways that DL methods can enhance the quality of teaching in engineering laboratories. This is one of the main goals of the ESCOLA project in which the University of Ruse is a partner. Thus this article presents for discussion some current results from the project.

## EXPOSITION

**Existing methods of distance learning which are applied in modern higher education and are supported by international standards for quality.**

Distance learning or distance education is a field of education that focuses on the pedagogy/andragogy, technology, and instructional system design that are effectively incorporated in delivering education to a student, where the teacher and the student may communicate asynchronously and synchronously (Mubarak Al-Khatir Al-Arim, A., 2014). Distance Education is basically a learning / teaching methodology, an educational concept, very closely related to special learning materials and has a differentiated role for the new teacher vs. the traditional one. In educational procedure, technology has a vital role, which intermediates in order to create a two-way communication between teachers and learners for the learning process of the learners (Panagiotakopoulos, C., Lionarakis, A., Xenos, M., 2003). DL is an instructional delivery system that connects learners with educational resources. It provides educational access to learners not enrolled in educational institutions and can augment the learning opportunities of current students. The implementation of DL is a process that uses available resources and will evolve to incorporate emerging technologies (OTAN, 2018).

The International Organization for Standardization (ISO) has published 40 international standards in the field of ‘Information technology for learning, education and training’. 16 additional standards are at different stages of development by the Joint Technical Committee ISO/IEC JTC 1/SC 36 (ISO/IEC JTC 1/SC 36, 2018). ISO/IEC 2382-36:2013 *Information technology — Vocabulary — Part 36: Learning, education and training* is intended to facilitate international communication in information technology for learning, education and training. It presents, in two languages, terms and definitions of selected concepts relevant to the field of information technology for learning, education and training, and identifies relationships among the entries (ISO/IEC 2382-36:2013, 2013).. This international standard specifies the main terms and definitions related to DL such as:

- web-based learning;
- on-line learning;
- computer-supported collaborative learning (CSCL);
- computer-based learning;
- blended learning, and others.

This standard is being revised and by 27 July 2018 it is in its Final Draft stage. Similar standards, both ISO and GOST, are listed in the references (GOST R 52653:2006, 2006).

When quality of DL is the focus of discussion, one needs to consider ISO/IEC 40180:2017 *Information technology - Quality for learning, education and training -- Fundamentals and reference framework*. This standard was published on 10 October 2017 and provides the fundamentals and the reference framework for quality assurance, quality management and quality improvement in IT-enhanced learning, education and training (called E-Learning). It consists mainly of the Quality Reference Framework (QRF) for E-Learning, which is a common and generic framework to describe,

specify and understand critical properties, characteristics and metrics of quality. The QRF combines an elaborated and extensive process model with a descriptive model for the processes. ISO/IEC 40180:2017 harmonizes existing approaches, concepts, specifications, terms and definitions related to quality for E-Learning, education and training.

**Forms of distance learning.**

The forms of distance learning could be classified into three main groups: e-learning, online tutorials, and m-learning (Fig. 1). An online tutorial is a self study activity designed to teach a specific learning outcome. The online tutorials are usually delivered via Blackboard but can also be made available via the Internet or on a DVD. There are two main types of online tutorials which are referred to as Recorded tutorials and Interactive tutorials. Recorded tutorials are video or screencast recordings, typically of a subject expert presenting information and ideas or giving a demonstration. Interactive tutorials are a structured collection of navigable web pages. Individual pages can contain any combination of text, images, audio, video, self test questions and other interactive activities.

Interactive tutorials can also contain screencasts. Web-based serious (educational) games can also be viewed as an online tutorial.



Fig. 1. Forms of distance learning



E-learning is a type of instruction that is delivered electronically, in part or wholly – via a Web browser, through the Internet or an intranet, or through multimedia platforms such as CD-ROM or DVD (Hall, B., 1997). It is a structured, purposeful use of an electronic system or a computer in support of the learning process (Allen, M.W., 2003). E-

learning covers a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes delivering content via the Internet, intranet/extranet (LAN/WAN), audio and videotape, satellite broadcast, interactive TV, and CD-ROM.



M-learning (Mobile learning) is learning through mobile computational devices (Quinn, C. (2000). M-learning is not just electronic; it is mobile (Shepherd C. (2001). A mobile learning educational process can be considered as any learning and teaching activity that is possible through mobile tools or in settings where mobile equipment is available (Colazzo, L., Molinari, A., Ronchetti, M., & Trifonova, A., 2007). It is a form of education whose site of production, circulation and consumption is the network (Polsani, P. (2003). M-learning is also defined as any form of learning (studying) and teaching that occurs through a mobile device, or in a mobile environment (Trifonova, A., 2003).

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The advantages and disadvantages of distance learning forms are compared in Table 1.

Table 1. Advantages and disadvantages of distance learning forms

	Advantages	Disadvantages
E-learning	individualized instructions, easy access, available to disadvantageous people, flexible in terms of delivery media, provide opportunities for testing and evaluating, peers and auto-instructional devices and software	requires special knowledge and skills, more costly than traditional education; negative attitude; affects the eyesight; feeling of isolation and missing social contact; E-learning stops when a technical defect occurs
M-learning	increased mobility, time-saving, environmentally friendly, interactive, use of relatively inexpensive everyday technologies, good support for preferred modes	storage capacities are limited; the buttons on the keypad or stylus pens are small and can be tricky for some people to manipulate; small display; usable with some models only; network connectivity limitations
Online tutorials	free tutorials on the internet, self-adjusted learning speed, the learner can choose the sequence of the acquired knowledge, learn when necessary, increased motivation	not assessed, not controlled by a tutor, hard to choose the right one, lack of face-to-face contact; no laboratory experience

**Examples for distance learning**

Three examples for distance learning, applicable at the University of Ruse, are presented below:

- E-Learning ShEll 02 – <http://e-learning.uni-ruse.bg>
- Personalized M-Learning mathematic class (Matasić, I., Eret, L., Dumančić, M., 2011)
- Electronics tutorials – <http://electronics-tutorials.ws>

The E-learning platform of the University of Ruse includes educational materials such as lectures, seminar exercises, practical exercises, books and lecture notes, media types, images, videos, documents, binary files (for download), knowledge assessment, assignments, tests.

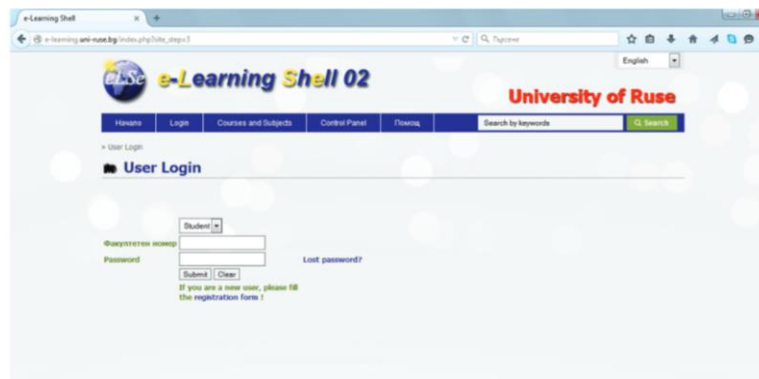


Fig. 2. E-Learning ShEll 02

A method to provide M-learning in mathematics includes educational materials such as theory, video clips of the teacher, mathematical problems, video solutions of the problem, and interactive play.

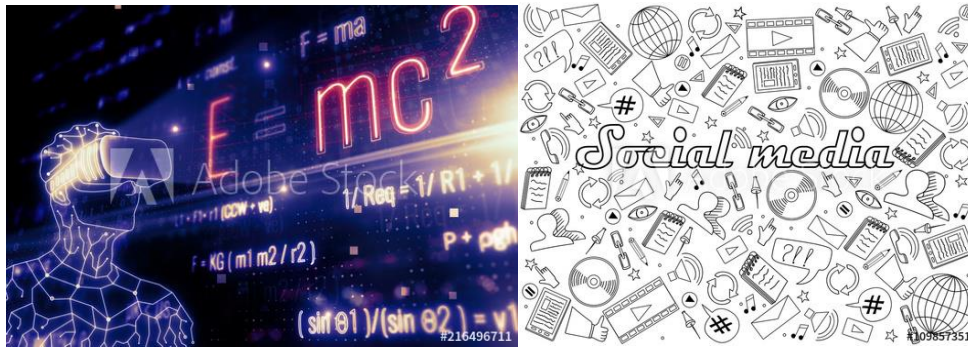


Fig. 3. M-learning in mathematics

Tutorial materials in the field of electrical and electronic engineering include educational materials such as tutorials and examples.

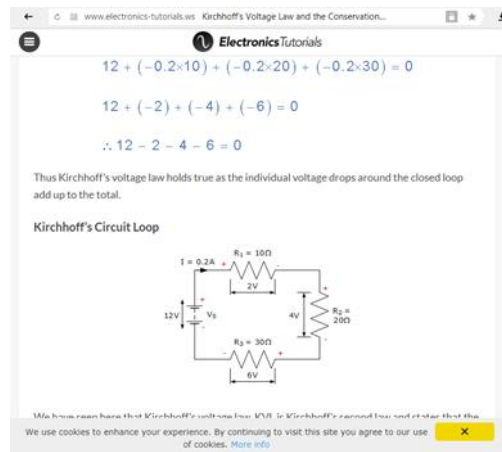


Fig. 4. Electronics tutorials

## CONCLUSION

The DL methods presented in this paper are applied at the University of Ruse in teaching engineering laboratories. Virtual laboratories are required to apply DL in engineering education. There are no limitations to the media type of the learning materials. However, to provide broader access, learning materials should be usable on both desktop PCs and PDAs. Interactive tools could be a good way to improve the motivation of learners.

## ACKNOWLEDGEMENT

This work was supported by the project No. 2017-1-TR01-KA203-045955 “Engineering Student-Centered Learning Approaches (ESCOLA),” financed under the Erasmus+ Program of the European Union.

The study was also supported by contract of University of Ruse “Angel Kanchev”, № BG05M2OP001-2.009-0011-C01, "Support for the development of human resources for research and innovation at the University of Ruse “Angel Kanchev”. The project is funded with support from the Operational Program "Science and Education for Smart Growth 2014 - 2020" financed by the European Social Fund of the European Union.

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