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DISTANCE LEARNING, SIMULATION AND COMMUNICATION 2017

Proceedings
(Selected papers)

Editor: Miroslav Hrubý

Brno, Czech Republic
May 31 - June 2, 2017

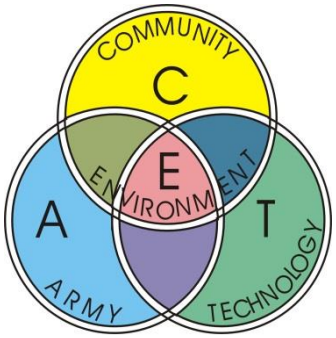
ISBN 978-80-7231-415-7

International Conference

DISTANCE LEARNING, SIMULATION AND COMMUNICATION 'DLSC 2017'

held as a part of

CATE 2017
(Community – Army – Technology - Environment)



under the auspices of

the Rector of the University of Defence

and

the Dean of the Faculty of Military Technology of the University of Defence

on May 31 - June 2, 2017

as an official accompanying programme of the International Exhibition of Defence and Security Technologies and Special Information Systems

IDET 2017

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Experience and information exchange in the field of:

- the current status and prospects of distance learning and e-Learning in the preparation of military professionals and other target groups;
- using the computer modelling and simulation, especially (but not only) in the command and control process;
- language education of military professionals and other target groups, current and future communication systems, their development and usage.

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CONTENT:

(MSL) MULTIPLE STEP E-LEARNING PRACTICAL – COMPUTED TOMOGRAPHY

Aleš Bezrouk, Tomáš Nosek, Martin Smutný, Martin Kopeček, Petr Voda, Josef Hanuš and Pravoslav Stránský
Department of Medical Biophysics, Medical Faculty in Hradec Kralove, Charles University
Simkova 870, 500 03 Hradec Kralove, Czech Republic
bezrouka@lfhk.cuni.cz, nosek@lfhk.cuni.cz, drsmutny@gmail.com, kopecema@lfhk.cuni.cz, vodap@lfhk.cuni.cz, hanus@lfhk.cuni.cz, str@lfhk.cuni.cz

Abstract: *Computed tomography is one of the important imaging methods used in a clinical praxis. The multiple step learning (MSL) concept is a way of e-learning course creation which reflects the previous knowledge of enrolled students. This paper describes the innovated MSL based e-learning course Computed Tomography. The course content is presented on three different levels of details. Every higher level gives the explanation of the problem using more details then the previous one. Therefore, it is possible to reveal some additional and connecting information only to students who need to know some interdisciplinary connections for better understanding. Based on the students' feedback, the MSL e-learning course Computed Tomography for the study year 2016/2017 was modified and enhanced with new step by step lab instructions. The impact of these modifications was tested.*

Keywords: e-learning, computed tomography, biophysics, MSL, adaptive systems.

INTRODUCTION

Medical biophysics belongs to cornerstones of education at medical faculties in Czech Republic in the first year. It is focused mainly on explanation of basic physical principles of physiological processes in human body and principles of function of medical devices. However, it is no secret that medical biophysics is not a favourite subject of students of medicine and their approach to it is often determined by that affection. Nevertheless, the rapid development of new diagnostic machines, which are based mainly on physical principles, gives a very good reason for making this subject more attractive. Future physicians should be aware of the capabilities and limits of available diagnostic machinery.

From the perspective of a physicians and medicine, medical biophysics is an interdisciplinary subject with broad range of interest and a lot of individual topics. For example, the scope of the research and teaching at the Department of Medical Biophysics of LFUK in Hradec Kralove includes advanced medical materials [1] and smart materials in stomatology [2], statistics [3, 4] and many other areas. These facts inevitably lead to the use of ICT – Information and Communication Technologies at this department [5–7]. According to Simonova [8] ICT attract students to educational process. ICT also help to individualize education and save expenses for paper materials. But, using ICT is not only about the individualization of education process and saving funds. If the previous knowledge of students is recognized, the corresponding further explanation can be omitted and significant amount of time saved as well; this cannot be overlooked, either. Saving time might be very interesting and attractive, especially for the first year medical students.

However, using e-learning or ICT in general is no panacea. Creation of a quality e-learning course is not as simple as it may seem. Because of the enormous variety and different quality of high school education and information sources nowadays, it is quite likely to have students who excel in certain topics but have totally insufficient knowledge of other topics. The multiple step learning (MSL) concept is a way of e-learning course creation which reflects the previous knowledge of enrolled students.

Computed tomography is one of the important imaging methods used in clinical practice. First year students of Faculty of Military Health Sciences of University of Defence have an opportunity to learn about principles of this imaging method during the practical classes in medical biophysics. This paper describes an innovated MSL based e-learning course Computed Tomography. The course content is presented on three different levels of details. The first level explains the topic completely but assumes deeper previous knowledge therefore some details are omitted. Every higher level explains the problem with more details and fills the information gap of previous one. Therefore, it is possible to reveal some additional and connecting information only to students who need to know some interdisciplinary connections for better understanding.

Based on the students' feedback, the MSL e-learning course Computed Tomography for the study year 2016/2017 was modified. Since the most frequent students demand was to save time to prepare for lab procedures and to have more details in instructional materials, the course was enhanced also with new step by step lab measurement instructions. The impact of these modifications was tested.

1. MATERIALS AND METHODS

1.1 CT course structure

Structure of the course was divided into the following basic sections: *Introduction* (basic description what is inside and for who it is intended); *How to prepare for practicals* (description of the 3 level MSL idea – how to study); *Preparing for the practicals* (sectioned CT lecture including intersection questions with feedback); *CT (computed tomography) - theory* (the main MSL concept lecture); *Online chat*; *Measurement theory* (the background of mathematics and physics of the practical class; what to calculate and what equations to use); *CT instructions* (how to use the devices and descriptions of the measurement procedures); *Glossary*, *CT – questions and answers* (chat with teachers), *Feedback questionnaire* (students feedback to the CT course).

1.1.1 MSL lecture

As described previously, due to an enormous variety of students' input knowledges, the e-learning course was divided into three different levels of details.

The 1st level is intended for those students, who are familiar with high school physics and remember the basic relationships and formulas related to the computed tomography topic (*e.g.*, absorption of ionizing radiation, linear absorption coefficient, half value layer (HVL), CT (Hounsfield) numbers, shielding against an ionizing radiation, x-ray tubes, Duane-Hunt law, exponential functions, logarithms).

The 2nd level is intended for “average” students for whom the physics is not an “archenemy”

The 3rd level contains the most detailed description of the topic (computed tomography) and is intended to those who need more in depth explanation or want to understand the broader context.

The individual levels are graphically distinguished by different colors and can be displayed or hidden using floating menus (Fig. 1).

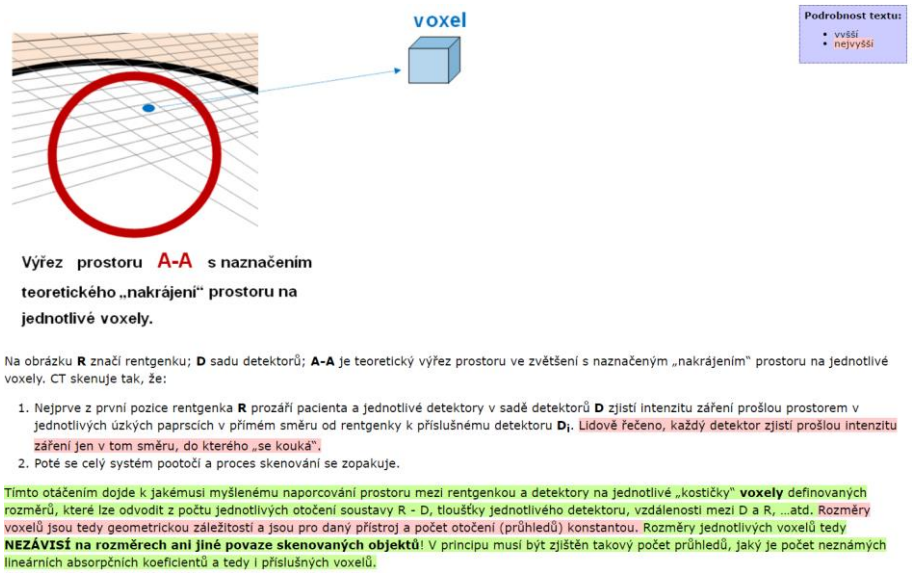

Fig. 1. Example of the MSL lecture – CT (computed tomography) – with typically highlighted text for specific levels (1st level – no highlighting; 2nd – intermediate level – green text background; 3rd – the most detailed level – red text background). The floating menu is in the top right corner.
Source: own

1.1.2 CT instructions

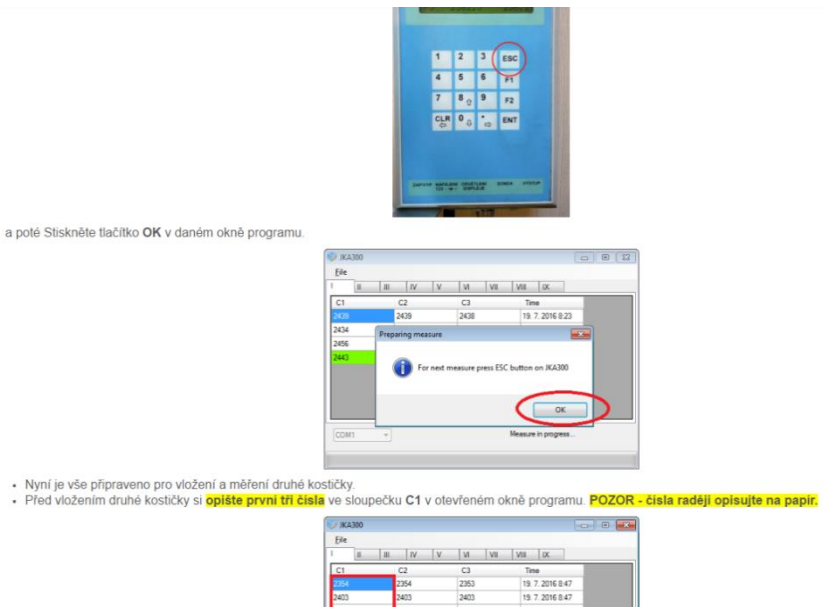

Fig. 2. Example of the step-by-step instructions
Source: own

Figure 2 shows the new pictorial material for preparation for lab measurements. It was made as step-by-step instructions with photographs of the devices. For each step of the measurement procedure, the control elements of the measuring devices and software application used are visually highlighted. Also the most important or critical procedure steps in the accompanying text are highlighted.

1.2 Statistical evaluation

The results were compared, processed, and statistically analyzed using MS Excel 2007 (Microsoft Corp, Redmond WA, USA) and NCSS 2007 (NCSS LLC, Kaysville, UT, USA. www.ncss.com). The chi-squared test was used. The value of $P<0.05$ was considered as statistically significant.

The cumulative levels of success, related to the topic CT – computed tomography, in the final exam tests 2016/17 (after application of the modified MSL e-learning course CT) vs 2015/16 (before modifications) were compared. In these tests, the topic CT was represented by 4 types of questions: Shielding against an ionizing radiation (Shielding); CT (Hounsfield) numbers; Half value layer (HVL); Duane-Hunt law. The level of success in each test was based on the ratio of the number of correct answers vs the total number of answers. For a better idea the examples of the questions used in the tests are presented below.

Shielding: A board 1.5 cm wide made of material with lead content absorbs 75.1 % of gamma radiation. The board of same dimensions but made of a material with content of iron lets pass through 75.1 % of radiation. How many percent of the radiation are absorbed by both boards used together? (81.3)

CT numbers: The linear coefficient of attenuation μ for given tissue is 0.047 cm^{-1}. Calculate the CT number of the tissue (μ = 0.19 cm^{-1}). Enter the result as three significant figures of integer. (-753)

HVL: Gamma rays go through a wall made of two layers. Each of the layers is 2.0 cm thick. The linear coefficient of attenuation of the first layer is 44.0 m^{-1}. 9185 photons per second enter the wall and 682 photons per second leave the wall. How many cm has the HVL of the second layer? (0.806)

Duane-Hunt: X-rays used for a radiologic examination were obtained using the anode voltage of 57.8 kV. Calculate the maximum frequency of this radiation. Enter the result in s^{-1}. (1.40e19)

2. RESULTS

The very first benefit brought by the new updated e-learning course CT – computed tomography was the evident time saving. The duration of the measuring lab class CT (approximately 2 hours in total) was shortened by almost 20 minutes. Students appreciated this very much and used the saved time primarily for processing of the protocols from measurement. Also teachers spent much less time explaining the individual steps of the measurement procedure and could concentrate more on explanation and clarifications of the key physical principles and pitfalls of the subject matter.

The individual levels of success (Fig. 3) for specific type of question (*CT numbers*, *HVL* or *Duane-Hunt*) show insignificant but distinct positive change in the test 2016/17 when compared with the test 2015/16. Figure 3 shows that there is no (or negligibly negative) change in the level of success only in question *Shielding*.

Moreover, the cumulative level of success of the test 2016/17 is significantly better (higher) when compared with the test 2015/16 as can be seen in Table 1.

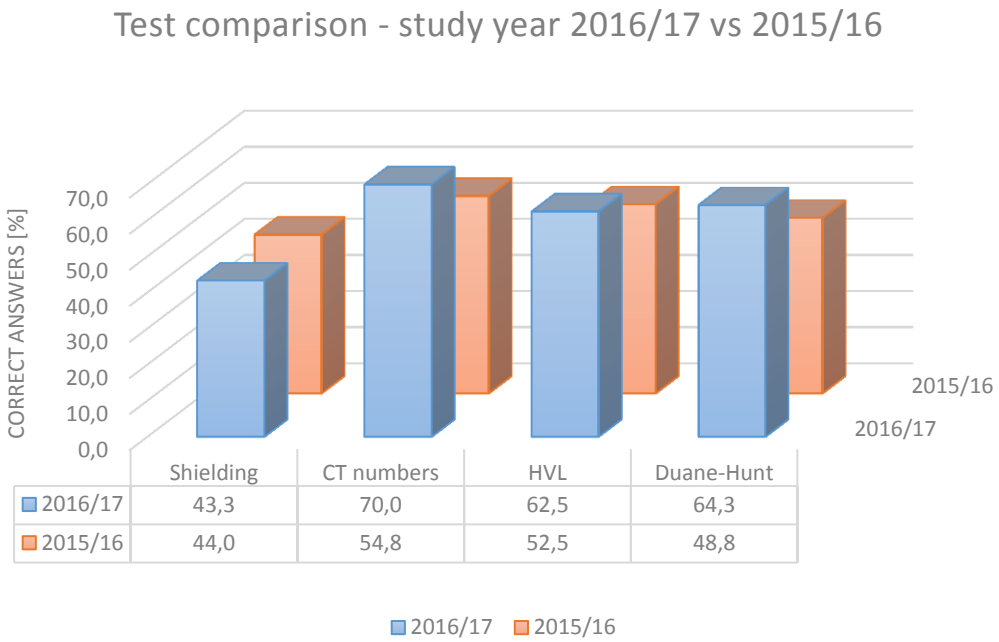

Fig. 3. Comparison of individual levels of success for specific test and type of a question.
Source: own

School Year		Number of answers
2015/16	*correct*	*164*
	total	*328*
	ratio [%]	*50.0*
2016/17	*correct*	*139*
	total	*232*
	ratio [%]	*50.9*
P - value		***0.0204****

Tab. 1. Comparison of the 2015/16 vs 2016/17 final exam test cumulative levels of success, related to the topic CT – computed tomography, represented by the *ratio* [%] of the number of correct answers vs the total number of answers. The asterisk (*) indicates significant difference.
Source: own

CONCLUSION

The new modified e-learning MSL course CT – computed tomography which was used for preparation and during the practical classes in the school year 2016/17 proved to be better than the old version. It substantially saves the time necessary to successfully complete the measuring practical class. The course also helps students to understand better the key physical principles and pitfalls of the subject matter. This was finally proved by the significant change in the cumulative level of success as well as insignificant positive changes in the individual levels of success in the test 2016/17 (*i.e.*, after application of the new modified e-learning course CT – computed tomography) when compared with the test 2015/16 (before modifications).

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Acknowledgement

This work was supported by the programme PROGRES Q40-09.

SIMULATION OF INFRASTRUCTURE FOR AUTONOMOUS SYSTEMS

Josef Botlík, Radim Dolák and Milena Janáková
Silesian University in Opava, School of Business Administration in Karvina
Univerzitní nám. 1934/3, 733 40 Karviná, Czech Republic
botlik@opf.slu.cz, dolak@opf.slu.cz, mija@opf.slu.cze-mail

Abstract: *The paper deals with design and simulation of infrastructure that will be suitable for the movement of autonomous systems based on a basic definition of nodes and links. It introduces the models that are generated by own simulation tool that is based on the real infrastructure of the Czech Republic at the level of statistical unit NUTS and LAU. Infrastructure is built based on deviatilites and reduced orthodromic distance. There is subsequently implemented on the infrastructure the quantification based on required network parameters and requirements of autonomous systems. There are defined the orientation and sought the local minima and maxima that are affecting the movement of autonomous systems in the infrastructure by using precedence. Presented model and simulations can be used to create structures applicable in command of process management.*

Keywords: model, precedence, region, infrastructure, simulation, autonomous system.

INTRODUCTION

There is taking place research in the area of an autonomous system on SU FPF (Silesian university in Opava, Faculty of Philosophy and Science in Opava), computer science department. Another applied research, especially in the area of regional and socioeconomic analysis and simulation (regional analysis – SGS 20/2014 analysis enterprise environment of district Karvina, model – SGS 5/2013 Precedential analysis exclude switch biasing interference transport infrastructure and regional development, simulation – SGS 19/2016), is taking place at SU OPF (Silesian University in Opava, School of Business Administration in Karvina). In the framework of these researches are generated and tested general model for opus infrastructure based on flowchart and incidence NUTS that allow identify and analyze the behavior of the autonomous system in specific, regional environment.

The motion of the autonomous system in the real world requires defined infrastructure. Ostensibly unlimited moving in the space and time is defined by target, trajectory, initial and final state (including space displacement). Goal-seeking behavior belongs to basic behavior of the autonomous system. Attainment target state autonomous system is conditioned philosophy decision – making of the process. There must exist swing from required target state, removal this abnormality have to be required in case that way solution is not known in advance.

From this list, it implies that the final behavior with be enacted a goal-seeking behavior autonomous system to infrastructure defined initial and leaf node and join between by the following nodes, which allows for behavior exploit basic systemic quantities and tools, especially then flowchart and incidence (relational) NUTS.

Come out from the assumption that the goal-seeking behavior is conditioned attainment target

state (target point), it is possible to define trajectory on the basis knowledge initial and endpoint and on the basis fulfillment set optimization conditions. Thus it is possible on the basis initial and balance closing and conditions always to define infrastructure, after which with the final autonomous system will move.

The motion of the autonomous system is conditioned by appropriately designed infrastructure. Further, it will be conditioned by attainability sectional points to trajectory and option next paths by optimization criteria. It is possible therefore recap that the general it is possible any behavior define infrastructure (physical or virtual) and decision – making the trial. As an autonomous system, it is possible subsequently to define the arbitrary entity. Principles of analysis can then be used for regional development analysis of socioeconomic variables.

1. DATA AND THE CURRENT STATE OF KNOWLEDGE

Current data trends of regional analysis are founded predominantly to the statistic-mathematical methods, judges regional disparity generally by force of multicriteria analysis of standard socioeconomics factors set. On the comparison, the basis is eventually generated clumps of regions with analogical parameters. Although there exists at extensive systems clumps spatially faulted (e.g. municipalities with extended jurisdiction (MEJ) Karvina region), where it is possible to trace up analogical value and trends behavior analyzed quantities, general this analytical approach, e.g. huddle analysis, or else summarize eligible regions by some criteria, don't take however view to environment, that there has been outside these regions let us say between farther eligible regions. Is, therefore, needs to implicate in regional analysis and regional ties (defined just infrastructure), as next tool flaring current techniques analysis. Show that is, therefore, needed to analyze regional systems not only from the view of values regional factors but also in context space structures. By one of the criteria applied for flaring comparison can be status surroundings. Prove appropriately define the connection between eligible regions, we can watch interregional flows quantities (unemployment, intelligence, the density of communication, the state of origin by elected criteria.

On need integrate spatial relation into single dynamic frames in connection with the discrepancy between slow and speedy trial alert e.g. Anderson (2015). Usefulness substandard methods and new analytical approach for analysis spacious geographic systems with the aim of data segmentation to level regions with yet available homogenous data (NUTS, eventually LAU, NUTS – nomenclature territorial statistic drives for statistical purposes Eurostat for comparison and analysis economic indicator, statistic monitoring, preparation, realization and classification regional policies member EU countries LAU local administrative unit, LAU1 – counties, LAU2 – village) show and published results based on analysis package of dates for group East European member state EU (e.g. Melecký and Staníčková, (2014), Staníčková, (2014)). Extensiveness and space dependencies regional analysis at the level NUTS mentions items Smit et al. (2015). Marginally with to issue express items Viturka (2013), which features results classification making social origin/background behind micro-eligible regions (MEJ) and meso-regions (NUTS 3) the Czech Republic. Viturka (2013) exhibits need ties selector region to surroundings, elected is, however, standards of practice segmentation regions to a subset, let us say synthesis subsets into of the whole. Work denote drop under examination values towards borders regions, thereby is further intimated need examine vector changes quantities, especially mainstream and intensity, in space context, mention in passing items e.g. in Botlik, Botlikova, (2013). About nodal and next functional space relationships

deals Klapka et al (2013). The existence of other types structures in regional analysis, for example, ties to the theoretic natural transport system are described in next literature (Kaňka, Ježek, 2013). Featured sources result in four – square need acceptance interregional relationships and comparison values factors in regions with expediently defined structures. This principle lets utilization potential cumulative in the surrounding region both Push and Pull principle.

2. TARGET AND METHODOLOGY

Target research is modeling general structures for regional analysis Czech Republic and identification relative extreme watched quantities, influencing the behavior of the autonomous system. To simulation be formed model generating linear infrastructural systems that the extras eligible regions to the elected structure. Emphasis is laying to versatility system and usability and to by other regional levels. Textures it is possible to generate expediently, which start from finality analysis and from of the bankrupt's estate system definition (the system is expediently defined set). To creation, structures are available several basic process and principles, by force of which we can define the link between eligible regions. It is possible to trace up two basic set structures, physical and virtual (fictive). Practically most widely used is method border physical structures, when are captured constraint (the physical boundary between pair regions). Adjacency in the analysis has standardly used the tool, employs she e.g. Anderson et al. (2015), Sardavar (2012).

Next types physical structures, used in the regional analysis be found either to belonging to above – regional structure (the structure is defined belonging to the superior region, no physical adjacency) or to availability to central element (availability regional cities, availability to airport, attraction zone revenue authority state of origin. Latest type physical structures used in the regional analysis is existence infrastructural demarcation strip (link regions through highway, railway, energy system state of origin. Exit and next physical ties, you, however, no dwell in regional analysis substantial comprised.

Techniques virtual structures generate fictive ties, founded either to determination availability without exploration existence physical paths, or to identity values watched quantities. At first case with the most conference on ties generated to geographic on the basis, by force of geographic coordinates, when are camping, for example, the minimum distance between subjects (eligible regions). Next, generally huddle analysis, (e.g. Kožiak et al. (2014)), let us say variant access (e.g. Mederly et al, (2004)), eligible regions grade by pick out factor (mostly yet in the framework multicriteria classification), but erased from geographic context (dishonor mutually adjacency). More about to a given problems was published to Colloquium about regional sciences (e.g. Botlík, 2016).

Considering contemporary regional issues, especially to migration crisis, put on to importance especially techniques conversant minimum clearance and virtual structures, which is by virtue of absence border checks among the states Schengen zone, absence borders (a posteriori "passing a hurdle") between NUTS 2 eligible regions and last but not least creation artificial migration flows except priority transport infrastructure.

From the view of generated system be a consequence relationship (connection) system that allows through autonomous agent system between arbitrary eligible regions. Thus it is possible subsequently generate vectors variety of length identifying changes values watched

factors between eligible regions (creation flow). It is possible to identify virtual structures as infrastructure defined by techniques of minimum clearance (networking with ***n*** nearest features on the basis orthodrome, by increasing the value n it is possible to reach connection). Further (partly) by force of continuous geometrical methods (triangulation method, hexagonal method), when with search basic ties (at triangulation techniques minimum clearance for ***n*** >=2, these ties are subsequently connected with one another to triangle). By increasing the value ***n*** it is possible general reach connected graph. Connection warrants items method based on identification (minimum) skeleton (Graph G is coherent if for every his two vertices x and y there has been in G road from x into y. Journey in graph is succession vertices and edges (v0, e1, v1,..., et, vt), where tops v0,..., vt are each other variety of vertices graph G and for every and = 1,2,...,t is ei = {vi-1, vi} ϵ E(G). Circle (cycle) in graph understand succession vertices and edges (v0, e1, v1,..., et, vt = v0), where tops v0,..., vt-1 are each other variety of vertices graph G and for every and = 1,2,...,t is ei = {vi-1, vi} ϵ E(G). The tree is connected graph devoid circle. Skeleton graph is subgraph, whose toll splice all vertices original graph and together itself does not contain any circle. Arbitrary tree (V,E'), where E' ϵ E, call skeleton graph), this method, however, a plastic adequate number structures in system and interlocks enough elements for comparison connected elements. Techniques with they may pervade and supplement. A common feature of all these methods and approaches be formed final nut adjacency (incidence or relational) and possibility follow - up defining orientation elected structures into the precedential nut, thereby is enabled analyze flows quantities to defined structures.

3. MODEL, GROUND DATA

To analyses be formed model, that were defined by as general, enabling definition arbitrary nets on the basis real physical infrastructure (hauling distance, throughput nets, traffic capacity state of origin or virtual infrastructure (defined on the basis availability and attainability by force of geographic location, regardless of physical infrastructure). Criterion is formed coherent infrastructure with "acceptable" density on the basis defined criteria. In this analysis, model defines ties as the minimum distance between watched nodes. To creation infrastructure being used the multiagent system. Own modeling infrastructure is formed search minima on the basis geographic coordinates, for every node (MEJ) is on the basis random passage nets sought nearest "appropriate" surroundings. The model allows search predefine count structures. The model further allows distinction found a link between points A and B a posteriori orientation AB or BA. To ensuring uniform dislocation structures may be completed infrastructure on the basis triangulation, for ensuring continuous system it is possible as starting infrastructure apply minimum skeleton. Infrastructure is further optimized repeated passages. Infrastructure is recorded by force of incidence binary NUTS.

In this analysis was defined infrastructure about two edges with triangulation. This limitation (only 2 minima) is by virtue of data circumference. To defined infrastructure allows further model compare value specified factors. On the basis, values factors are set mainstream increase or drop analyzed parameters. Changes are watched between neighboring features to defined infrastructure. Thereby visit creation oriented infrastructure, for interception are used a precedential nut (nut precedence). To modeling and simulation being used software MS Excel. Model has four strata. Render generated binary incidence matrix. Nut captures on the basis defined parameters infrastructure. Binary type NUTS are elected on the ground of dimensions nut (in featured simulation 6129x6129 elements) and from that flowing limitations. To analyses, it is possible to apply operation thin NUTS and method composition

nut selective vector (comprehensive about method deals e.g. Langefors, 1973). To a generation, the matrix is sufficient to data, identifier element, and identifier ties.

Model further exploits determination gradient and precedence to identification relative extreme. We have defined by force of incidence NUTS and subsequently by force of multiple precedences. Precedence is defined overleaf layer model. Upon this layer are compares data single analyze factor. Value are hand on by force of vectors that it is possible either convert the binary matrix to numerical or fix differences values elected factors in first with structure. Considering data circumference model exploits determination differences values, subsequently determination gradient and records mainstream (precedence) into the precedential nut that is off again binary. On the third level with by force of multiplication precedential NUTS identify multiple precedences and are calculated reduced orthodrome (reduced orthodrome start from reduced directness, when isn't computed the relationship between real distance and orthodrome but is computed the relationship between multiple precedences (unitary distance) and orthodrome). Model is destined to generation specific infrastructures, especially at regional analysis. These analyses are specific homogeneity infrastructures. Together it is possible to define infrastructure expediently, on the basis analyze factor. Presently is into model implemented the fourth layer, when is tested change infrastructure on the basis behavior autonomous system in nodes by force of tools Petri - net and queuing system. Considering extensiveness analyzed of dates wasn't this layer in this contribution used.

In the framework research was synthetic infrastructure village the Czech Republic on the basis dial village. On the ground of extensiveness of dates is infrastructure present in contribution reduced to South Moravian country. Given data were to be extracted and mine from statistic foundations RUIAN (register territorial identification, addresses, and real property) and dials MVCR (data groundwork available: http://nahlizenidokn.cuzk.cz/stahniadresnimistaruian.aspx, http://www.mvcr.cz/clanek/databaze-adres-v-cr-a-ciselniky-uzemnich-celku.aspx, http://33bcdd.github.io/souradnice-mest/). The dataset includes identification data (GPS coordinate, belonging to the county, to the county, code village etc.) for 6129 village Czech Republic (673 villages South Moravian county).

On the basis, identifier village is subsequently referred value pick out factor. Value factors were to be mine from database Czech Statistical Office. In contribution are present data "Unemployment", "Index of aging", "Index economics dependencies" and "Coefficient of ecological stability", as a data segment, having significant influence over making decisions autonomous system for motion in the direction of the region or for rejection head (decision-making process).

4. THE RESULTS OF RESEARCH, DISCUSSION

It was generated infrastructure using the mentioned model. The first phase was an attempt to make the simplest architecture. Due to the extensiveness of the system (6129 villages) were generated for each municipality only two edges and a triangulation. The infrastructure was not continuous.

Figure 1 shows a segment of municipalities and the South Moravian Region Mackovice detail around the village in the district of Znojmo (village number 594407). This area shows considerable segmentation.

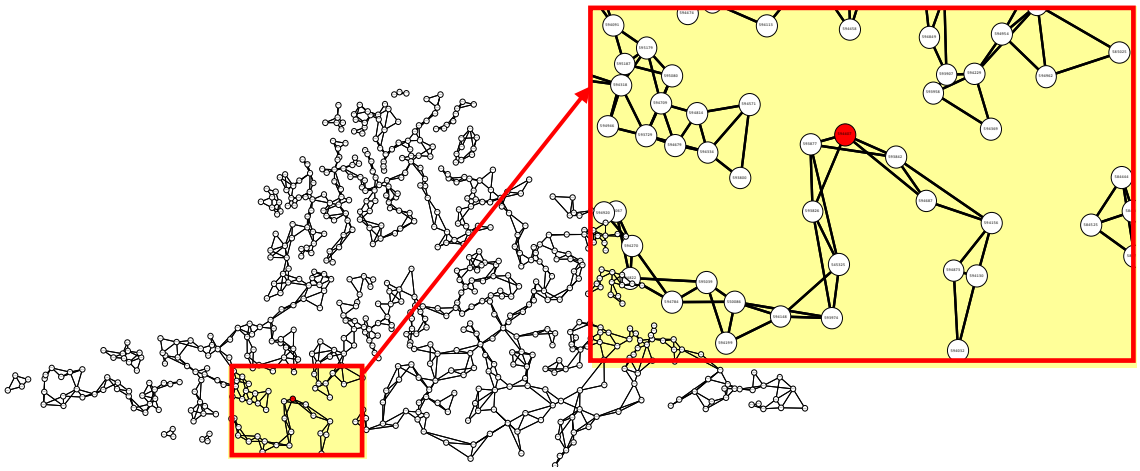

Fig. 1. South Moravian Region - incoherent infrastructure - great-circle distance
Source: own

The infrastructure has been extended to the next stage of analysis. Defined were again two edges and triangulation, if they were assigned to one edge of the village identical with the edges of other municipalities were not accepted and have found a new edge. New infrastructure (Figure 2) has been continuous in this case.

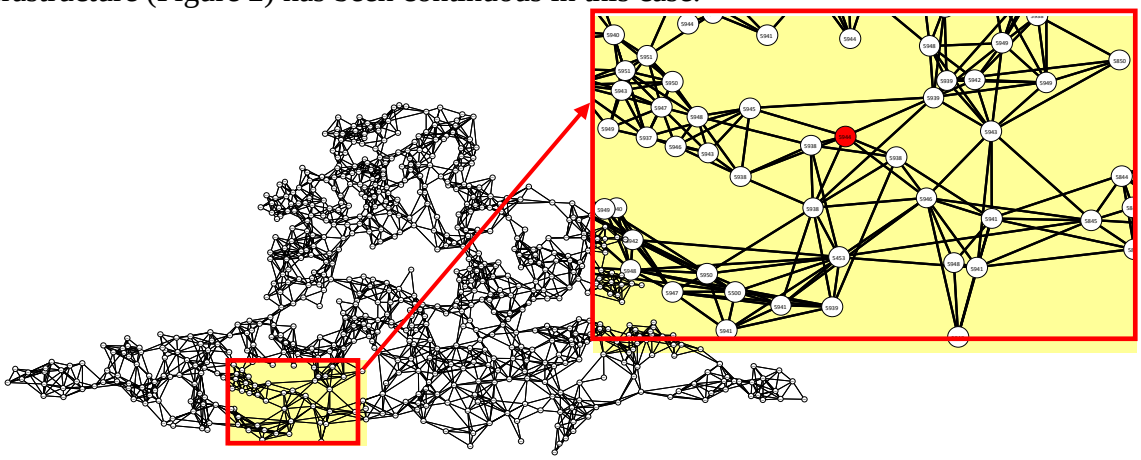

Fig. 2. South Moravian Region – continuous infrastructure - great-circle distance
Source: own

On this infrastructure were subsequently generated precedence.

At the bottom of Figure 3 is shown the direction of the Index variables of age, Variable economic burden index, Coefficient of ecological stability and a further multi-criteria evaluation of these parameters on the basis of the order of municipalities in various quantities specified functions RANK.EQ (function MS Excel RANK.EQ (number, link [sequence]) returns the sequence number in the list of numbers, thus its relative size relative to other values in the list. If the same order multiple values will be returned to the highest rank given a set of values. If there is an ordered list of fields, the order numbers by size while its position in the list). Said links are the first Precedence and serve as the decision-making functions for autonomous agents in the event that the node decides on the direction of the next steps and prefer a given factor.

For autonomous decision-making system, it is possible with multiple precedences to determine the great-circle distance reduced. An autonomous system can analyze their decision making according to the values of behavior factor for longer trajectories.

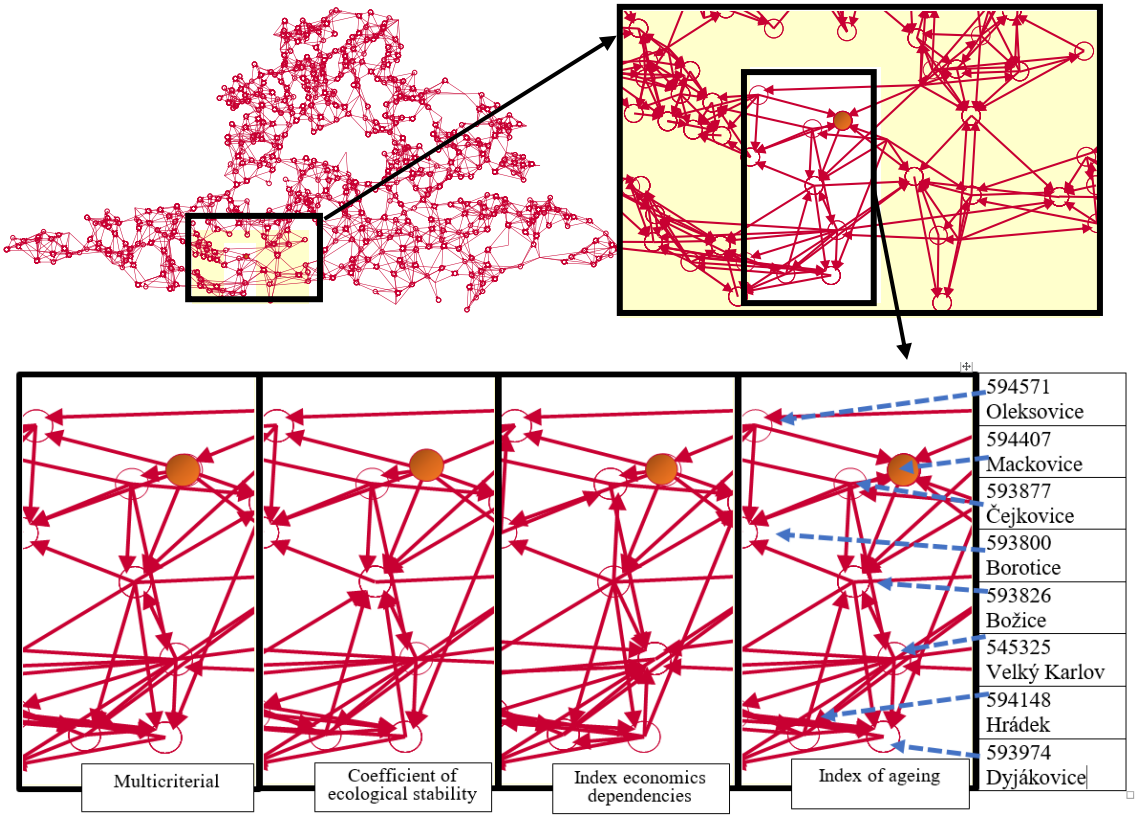

Fig. 3. South Moravian Region – selected municipality – routing variables
Source: own

Figure 4 shows a second precedence. Directions Precedence show route of which there are an increase factor values between the three municipalities. Similarly, you can use for decision making multiple precedences, in which case you can find the local extreme values and establish unique ways to reach extremes between municipalities.

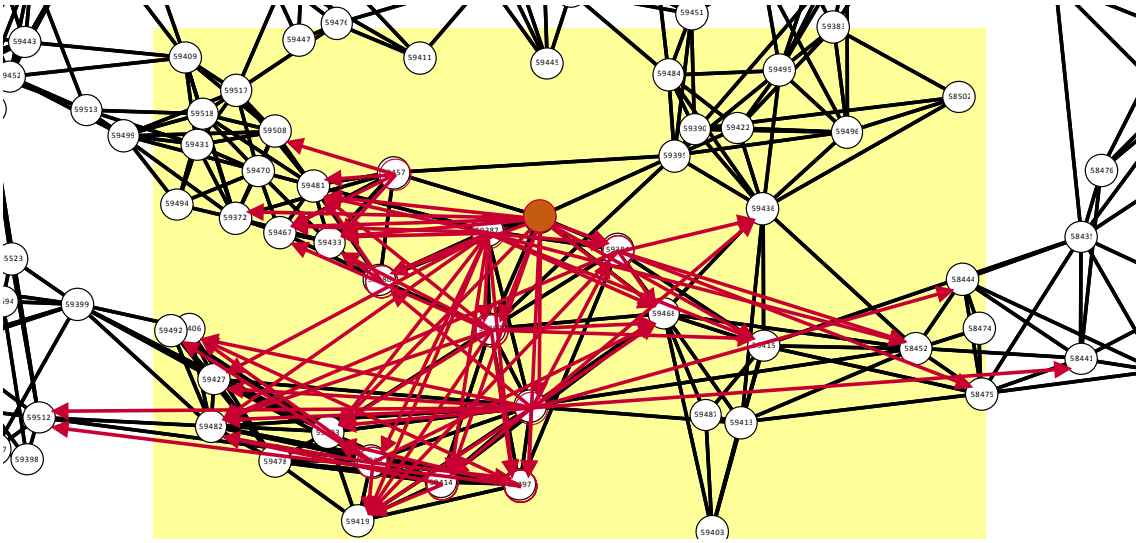

Fig. 4. South Moravian Region – reduced ortodrome – the second precedences (selection)
Source: own

CONCLUSION

Featured contribution clearly demonstrates the use of simple infrastructures defined and presented binary matrices in the decision-making process of autonomous systems. It was demonstrated continuous identification of infrastructure based on the requirements on infrastructure bonds. It has been demonstrated the use of precedence in decision making autonomous systems. It was modeled specific infrastructure for regional analyses and demonstrated in the municipalities of the Czech Republic. It confirmed the hypothesis that the apparatus precedent NUTS can be used for autonomous decision-making systems.

From the present research is also the apparent absence of tools for controlling the passages of autonomous systems on the basis of local extremes. These preconditions are given for further research, which can be used for controlling instruments of Petri networks for control of transitions between nodes. At the same time, it seems to use implementation tools queuing systems. Using these tools can eliminate the current lack of a model collision while moving more autonomous systems for infrastructure and resource depletion (reduction of possible values of the critical factors in knots).

Reported extension model is subject to the next stage of SGS 19/2016 project solved at SU OPF.

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Acknowledgement
The work presented in this paper has been supported by the SGS/19/2016 project called "Advanced mining methods and simulation techniques in business process domain".

DISTRIBUTED SIMULATION AS A PLATFORM OF SECURITY COMMUNITY PREPARATION

Pavel Bučka and Vladimír Andrassy
Defence and Security Department, Armed Forces Academy of General M. R. Stefanik
Demänová 393, 031 06 Liptovský Mikuláš 6, Slovak Republic
pavel.bucka@aos.sk, vladimir.andrassy@aos.sk

Abstract: *Security community should consist of highly qualified professionals being able to propose and implement the optimal way to resolve the resulting crisis. Their preparation is a continuous systematic process of gaining, expansion and acquisition of knowledge and skills leading to a successful management of the crisis and mitigation of its consequences. Therefore, it is necessary to make use of previously acquired theoretical and practical experience in various fields of knowledge during the preparation of crisis managers, such as the theory of security risks, sociology, public administration theory and the available technical and information resources. The optimum seems to be the use of scientific methods of simulation in the form of distributed simulation. The application of simulation tools supports the perception of the reality of the crisis and highlights the importance of mutual cooperation among participating subjects carrying out specific actions addressing defined areas of responsibility.*

Keywords: distributed simulation, simulation tools, security community, crisis management, crisis scenarios.

INTRODUCTION

Security is understood as one of the basic human needs, as a sum of relationships and activities that protect the rights, health, life and property of citizens. Looking at the safety as a whole, it can be characterized as a state as well as a process, as a result of specifically targeted and ongoing activities and processes. Ensuring safety is an interdisciplinary process, the result of conscious human activity which seeks to protect against threats, and mitigate the potential consequences of using the output of natural, technological, social and human sciences. The created security system is a set of technical, operational, material, personnel and communications subsystems. These subsystems are designed for direct and immediate protection as well as prevention, information provision and rehabilitation. Individual subsystems are interconnected, functionally interlinked, and are in some cases interdependent integral part of the security system staff – security community.

1. SECURITY COMMUNITY

Security is influenced by several factors that are interdependent and are in constant evolution. It is a process variable in time and space. Violation of principles and rules in order to ensure security leads to weaknesses in the existing security system [5]. To be able to ensure the required level of security, we need to have enough critical and credible information required for the administrative decision and sufficient amount of trained personnel for follow-up action. The final quality of the security system (Q_BS) can be expressed as a function of the quality of technical means (Q_TP) in conjunction with the quality of staff (Q_PERS):

$$Q_{BS} = f(Q_{TP} \wedge Q_{PERS})$$

The gathering, dissemination and acquisition of knowledge and skills leading to a successful management of the crisis and mitigation of its consequences is a continuous, iterative process of preparing the security community. A professional security community should be highly theoretically and proficiently trained for prevention, optimal solution and subsequent consolidation of arising crises. It should be able to understand the triggers, the course of the crisis, assess the real situation and take action to tackle the crisis with optimal utilization of existing manpower and resources [3]. In the process of education of crisis managers is therefore necessary to make use of previously acquired theoretical and practical experience in various fields of knowledge such as the theory of security risks, sociology, public administration theory and the available technical and information resources. The optimum seems to be the use of scientific methods of simulation in the form of distributed simulation. The application of simulation tools supports the perception of the reality of the crisis and highlights the importance of mutual cooperation among participating subjects carrying out specific actions addressing defined areas of responsibility.

2. SIMULATION TOOLS FOR DISTRIBUTED SIMULATION

2.1 Distributed Simulation

A simulation of crisis situations is a process of specification, implementation and actual realization of a crisis itself along with models created to correspond the desired level of reality. The number of used simulation models depends on the method ensuring the mutual interactivity and interaction as follows:
a) the cooperation of several models – shared database through which the individual models transmit full information about the outcome of the storylines,
b) the cooperation of several hundred to thousands of models linked to one another, occurring in real time – Distributed Interactive Simulation (DIS).

DIS comprises of cooperating simulations that are connected into one larger, functional simulation unit. DIS creates a synthetic environment making possible to carry out simulations during emergencies, carry out training and find optimal solutions to complicated tactical tasks of uniform or common terrain, at the same time, the same weather conditions, when exposed to the same external influences. Such simulation allows mutual visibility of simulated participating entities as elements capable of altering the state of the system, the interactive action, the possibility of mutual radio communication, and last but not least the opportunity to influence and interfere in the tactical situation from the position of the control simulation. By utilizing the principle of DIS, simulated entities of a constructive simulation (defined algorithms), virtual and live simulation (simulated operator actions) that meet the requirements of cross-correlation, can interact in real time. DIS entities do not share a common database. They contain attributes – variables that have a unique value for a particular entity in the system. Each entity reports to other entities the change of its attribute by sending messages through a standardized protocol DIS. Receiving and processing input messages posted by DIS entities is an integral activity of each entity. This generates "a personal point of view" of an entity to a simulated world and its storyline, thus allowing the formation of their own actions and reactions contributing to the course of events in a simulated synthetic dynamic environment.

The exchange of information among simulation applications within DIS, a standardized DIS data protocol is being used, which is described in detail in STANAG 4482 Edition 2 – Standardised Information Technology Protocols for Distributed Interactive Simulation, IEEE Standard 1278.1 – Standard for DIS – Application Protocols, IEEE Standard 1278.2 – Standard for DIS – Communication Services and Profiles, IEEE Standard 1278.3 – Standard for DIS – Exercise Management and Feedback, Enumeration and Bit – encoded Values for Use with IEEE Standards. High Level Architecture (HLA) is a more recent, gradual implementation of standards describing the framework and rules of architecture for simulation identified as IEEE 1516 Standard for Modelling and Simulation HLA.

2.2 Software Simulation Tools

Simulation tools increase the efficiency of the preparation of the security community for events and facts that may be very difficult or extremely difficult to prepare for financially in the real world. They support the creation and analysis of reality, the generation of a model of a crisis and the subsequent simulation of its course, and provide information for finding solutions. Simulation ensures the balance of the essential features of a crisis, providing opportunities for a responsible decision making of a crisis manager. Authentication support, emergency plans, crisis management processes are in place allowing to test the effects and consequences of decisions, and experiment with the computer created models of real situations in order to obtain relevant documents for the optimization of operations and their solutions.

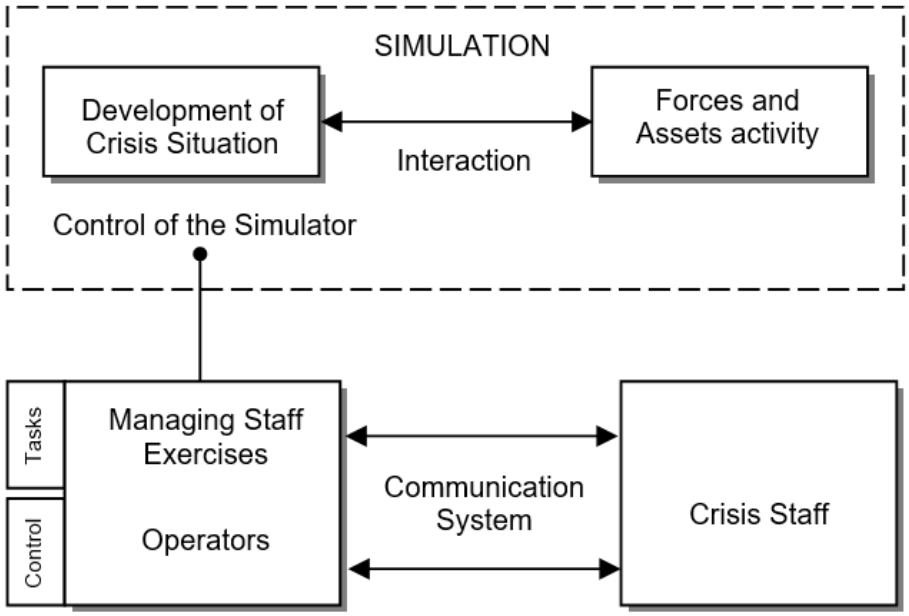

Fig. 1. Simplified principle of crisis simulations
Source: own

Support simulation tool *OneSAF Testbed Baseline* (OTB) represents a generation of simulation systems of a constructive simulation. It is an open system of hierarchically arranged software libraries – libraries of a computer generated entities, used to generate entities with semi-automated behaviour [4]. By entity we mean a simulated individual, vehicles, their actions and behaviour in dynamic synthetic environment that is shared by all

simulators logically interconnected within the DIS creating a web where all individuals are interconnected. Each entity is within the dynamic environment of a synthetic model of a particular element, and is semi-automated in the context of other elements. This means that it is able, along with the physical laws, to autonomously simulate the most basic level of decision-making and behaviour. OTB architecture is based on the nature of the design and operation of the DIS in high resolution, using personal computers with relatively low requirements for computing and graphics performance.

Architecture and solution does not place high demands on computers that perform a number of computational operations related to simulation activities and its visualization does not require including in the structure of the network the server computer. Virtual synthetic environment is characterized by a digital terrain database representing terrain rendering image maps of an interest area. It is possible to create surfaces, and insert point and line objects into digital maps. Movement and manoeuvre simulated entities are affected by the terrain over which the entities operate.

Based on the attributes of the field it is possible to simulate the visibility of entities making the simulation more real. The Scene Editor can be used to change the character of the scene by changing the weather settings (e.g. rain, direction, speed and strength of wind, temperature, dew point, humidity, pressure) and changing the day-time, which directly influences the behaviour of entities. The Entity Editor is divided into several sections where controlling elements deal with the specification of the inserted entity, its properties and its predicted activities (e.g. a person, vehicles, units). Created entity is able, on the basis of defined parameters or characteristics, to respond to assignments, implement and generate an activity (e.g. move along the desired route, to the point, patrolling, guarding, boarding and disembarkation of vehicles, overcoming obstacles, behaviour of crowds, the use of dogs, simulation of the injuries, hold and release of the hostages, a suicide attack) [1].

Support tool *OneSAF Objective System* (OOS) is a new system of constructive simulation that represents a whole new generation of simulation systems for DIS. OOS are based on DIS protocol or HLA architecture operable in optional simulation and communication environment. OOS architecture is completely new compared to existing DIS simulation systems, in terms of the design of data structures and entities and the format used for terrain database. OOS uses one computer as a server and other computers, so called SimHost computers, as additive servers. The configuration of technical equipment must provide a sufficient computing power of a SimHost computer, which must be dimensioned to perform calculations without conflicts associated with the simulation of all workstations that are connected to the SimHost computer. Compared to the system OTB, the architecture and technical solution do not place particularly high demands on computers that perform a number of computational operations related to simulation and visualization, but in principle require a completely different way of managing the simulation and implementation of computer-assisted exercises (CAX). The used solution notably complicates the process of "operating" the simulation system, particularly when being used as a tool for constructive simulation. However, the relative advantage is significantly attenuated in terms of managing exercises such as CAX when distributed responsibility for managing simulation (from the hardware and software point of view) is transmitted to the operator – the manager of the SimHost computer, and basically, during the simulation (exercise) it is not possible to perform "online" operational changes and respond to the requirements of the exercise instructor (e.g. modifying scenarios, completing or removal of entities). The principle of recording of simulation and its

playback during the simulation is carried out in a similar way to the OTB system in the area of application software for backup during the CAX.

Support tool *WASP* is a special software tool for constructive simulation allowing to simulate human activities, technologies and phenomena associated with human behaviour in an artificial (simulated) environment. It is designed for computer support of individual and tactical simulation of entities, technology and events placed in a generated synthetic virtual environment. WASP stimulates "role playing" and the development of events for development activities and related phenomena accompanying the corresponding real terms. Application software runs under Microsoft Windows operating system, hardware and software solutions provide ease of use, configurability and a good opportunity for system expanding. WASP system's synthetic virtual environment of real environments is created in the format OTFv8 allowing to define an extensive set of attributes of field elements [8]. Consequently, the generic synthetic virtual environment is used for creating a scenario needed to ensure the simulation, and 3D visualization for terrain database is used for a specific format. Graphical user interface allows to perform modelling and scenario building, supports simulation and management and display outputs corresponding to reality.

The described simulation tools are mutually interoperable, though the OOS uses its own communication interface for mutual communication among active station. Proper recognition and representation of different types of entities among OOS and other simulation systems within a distributed simulation requires the existence of proper mapping of DIS identification of entities in OOS. Talking about the connection to other simulation systems, OOS uses an existing interface ensuring the compatibility of the DIS or HLA protocols. OOS is a constructive simulation tool localized in the Armed Forces of the Slovak Republic, the Czech Army locates the tool as OneSAF.

2.3 Hardware Simulation tools

Hardware support tools use technical resources (computers) in a specific way allowing a credible imitation of various buildings, spaces and procedures corresponding to real world environment. It is a fast growing technology in the field of modelling and simulation and is a part of a general trend of penetration of new tools and methods in the crucial field of information society development. Hardware Support Tools provide users with virtual environment perception by means and equipment operating in visual, auditory and tactile senses.

Reconfigurable Virtual Simulator (RVS) is designed to support tasks in the area of tactical training of security community, preparing individuals, crews and operators focused on the development of tactical and communication skills in the area of command and control, procurement, provision and transfer of information. It also supports the solution of tasks in the field of psychological preparation, behaviour in stressful situations, decision-making under time pressure, etc. RVS can be configured for different types of ground and aviation equipment, including equipment of the integrated rescue system. It can be used for an individual training, but also as a warm up exercise realized within the CAX. It has an interface for interconnections using DIS protocol, making it compatible for use with the simulation tool OTB, OOS and WASP [6].

Team Leader Simulator (TLS) is a reconfigurable virtual simulator designed to support tactical training by adding individuals and small groups to DIS generated for solving crisis

management tasks. The basic function of TLS is to generate virtual synthetic environment approaching real conditions, and create the conditions for the support of tactical training of small units focusing on different types of groups / teams, mainly on military, rescue, police and fire departments with the corresponding technical equipment and capabilities. TLS develops coordination and mutual communication, tactical thinking, the ability to command and control, with an emphasis on decision making (e.g. exercises psychological preparation, behaviour in stressful situations, making decisions under time pressure) [7].

Virtual simulation is in the form of TLS complemented by environmental phenomena, separate modules and entities characterizing population, infrastructure and available technical means. Specialized software and hardware of the simulator provides two positions in separate cabins. The portrayal shows the point of view of simulated entities, by which the instructor receives the information in the same way as in real life and on the basis of observation, cooperation and communication with a cooperating entity / group / team. Simulation using the TLS occurs in real time with the possibility of managing the ongoing simulation (e.g. by setting the parameter of the weather, the insertion of fire, explosion), with the possibilities to control simulated land and air equipment, people, and animals.

3. CAX BASED ON THE DIS

Crisis scenarios appear more and more in the theory and practice of crisis management, which is a result of the risk assessment and the development of the security environment. They mainly focus on causes affecting the formation and course of a crisis describing the possible negative consequences for human life and health, social infrastructure, environment and society, but also the reactions and actions of the individual components of the security system of the emergence and escalation of threats and hazards [2]. The preparation of the security community using support tools enables a realistic analysis and specification of a problem, outlining mutual interaction, characterizing the situation and its impact. While solving a crisis situation, it is necessary to understand and know the answer to the question: "What happens if ...?", realizing risks and locations.

The aggregation of processes and fusion of knowledge and information in the field of crisis management as a whole reduces uncertainty and helps to prevent or mitigate relevant risks. In this way, linking theory and practice in the area of preparation of the security community with the use of support instruments is more than necessary, and especially when using crisis scenarios intermediating the progress and interconnection of isolated as well as related significant processes and phenomena in temporal and spatial dimensions. Software and hardware support tools help to verify the proposed approach or probabilistic values of received hypotheses. Based on the warm up plan, the simulation appoints specific tasks considering the content and objectives of addressed crisis. At the end of a simulation, based on the result of collected information, it is determined which activities will be analysed and in what way they will be presented.

The support tools exploitation provides a unified system of the security community training, the possibility of obtaining permanent habits and their renewal and unification of operational procedures with the maintenance of variation solutions to various random or standard situations. It seems very convenient to link educational process with practical activities where simulation technologies are being used to improve its quality, increase productivity and efficiency, create conditions for managers to train their abilities of coping with crisis

situations. Connection of the various types / kinds of software and hardware support tools is a logical result of the need and the current state of network information, communication and computer technologies. This improves the preparation for solving complex "tactical" tasks, the possibility of mutual radio communication, the use of technical means in the real environment approaching reality.

Fig. 2. Connectivity options supporting tools WASP, RVS, TLS
Source: VR Group, a.s. [9]

CONCLUSION

The preparation of the security community can be enhanced with computer simulation, which ensures originality and innovativeness in the area of dealing with potential crisis situations. The basic requirement for programming crisis scenarios simulating crisis situations and verification of decision process is to prepare realistic conditions for its implementation. The form, definitions and output products of CAX are evolving from the general to the specific, from the sketch to the final solution, from the general idea to a detailed implementation plan and resultant corrections during its course. We need to remember that the acronym CAX means a computer-assisted exercise. To express it in simple terms, the computer is one of several tools being helpful in ensuring the preparation of crisis manager.

Preparation of staff is often conducted in unrealistic conditions with nonexistent forces and means, without the possibility of correction and verification of performed tasks. CAX allows examiners to create a realistic view of the addressed crisis situation, a realistic environment, to form the necessary relationships and bonds, to find the optimal solutions. In 2015 and 2016, 28 CAX were conducted in a form of distributed simulation with a positive feedback from examiners from various areas of the security community (students of the Armed Forces Academy, Police Academy, crisis managers, military personnel).

Support tools for managers help to develop their skills in the area of planning and decision making having a real impact on the time and spatial factor of a crisis situation. They deepen the staff habits, synchronization of performed tasks and their continuity, strengthen cooperation and organizational skills, and develop habits of a proper use of forces and means.

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Acknowledgement

This article was supported by the outcome of the project "Workplace analysis and simulation and information security threat (PASIBO) – Analysis and Simulation of Information and Security Threats Workplace", code OPVaV-2015/1.1/03-SORO, ITMS code 26210120044.

DLSC CONFERENCE TOPICS IN ARTICLES ON WOS

Ladislav Buřita
University of Defence[1] and Tomas Bata University in Zlin[2]
[1]Kounicova 65, 662 10 Brno, Czech Republic, ladislav.burita@unob.cz
[2]Mostní 5139, 760 01 Zlín, Czech Republic, burita@fame.utb.cz

Abstract: *In the paper are analysed articles that are indexed on Web of Science (WoS) with the three main topics of the DLSC conference: Distance Learning, Simulation, and Communication. The relevant articles were retrieved at WoS and were chosen the most cited ones. The first step of analysis was oriented to statistics of the chosen articles and for the second step was used software Tovek Tools for detailed content and context analysis. The context analysis was depicted in the matrix form (number of papers with the same word) and the content analysis was prepared in the graph form in correlation of other words to word "distance" and to word "learning". The results of analysis verified the working hypothesis that the chosen articles in individual topic of the conference are independent and have no overlap into the other topics.*

Keywords: distance learning, simulation, communication, paper, WoS, analysis, Tovek Tools.

INTRODUCTION

The conference DLSC (Distance Learning, Simulation and Communication) with the three main topics is probably an original (only one) in the world of conferences. It is quite common that each of the DLSC conference topics is a content for a separate conference.

The author tried to find out, analysing published articles, indexed on Web of Science (WoS), whether the individual topic from the perspective of publications at WoS are truly independent, or have some interconnections. The first step of analysis was oriented to statistics of the chosen articles, identified the research areas in the articles, and summarized information about journals. The second step of analysis was oriented to text mining of the relevant articles using software (SW) Tovek Tools (TT) for detailed content and context analysis.

The case study analyses chosen articles from WoS, but it must be respected some restrictions, especially in the number of analysed articles and availability full text of papers. The findings from the research are therefore more as an enriching commentary on the conference, not the result of fundamental research.

1. RESEARCH METHODOLOGY

First, for each topic of the DLSC conference: "DISTANCE LEARNING" (DL) "SIMULATION" (Sim), and "COMMUNICATION" (Com) was determinate the number of relevant articles. The criterion for choosing was the occurrence of the DLSC topic key words in the title of searched articles. About the DL topic was found 2145 articles, about the topic

Sim 369091 articles, and about the topic Com 165934 articles. For further selection of relevant articles for the research was chosen criterion "the number of citations". For each topic was selected 15 articles, which were objects to further analysis.

The statistics analysis was carried out in topic on DL in articles [1] to [15], in topic on Sim in articles [16] to [30], in topic on Com in articles [31] to [45]. Articles in each section (DL, Sim, and Com) were arranged according to the number of citations in WoS. Analysis about selected articles included assignment to science; was prepared overview of journals with selected published articles; was found the five-year (2011-2015) impact factor (IF) for each journal. The authorial activity (if any author published more articles in the analysed section) was mentioned, too.

Further were analysed articles using SW TT (www.tovek.cz), in detailed questionnaires and in the content and context aspect (view). The working hypothesis: “Topics of the DLSC in the relevant articles on WoS are separated in the individual themes that have no (or minimal) intersection”.

2. TOPIC DISTANCE LEARNING

Topic DL has minimum WoS indexed articles (2145) of the three analysed topics, and these articles are also the least cited. DL is a topic that the authors devote relatively marginal. The most cited is the paper [1] (114) and the least cited is the paper [15] (19) of this section the summary of citation in section DL is 596. The research focus (or science) of the DL articles is in Tab. 1, list of journals is in the Tab. 2. The content of all articles in the section DL is oriented to education. The oldest article is from year 1997, the youngest from year 2012 (the youngest article of all); the average year of all articles in the section DL is 2003.

Science ⬇ Number of paper ➡	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
COMPUTER SCIENCE															
EDUCATION															
PSYCHOLOGY															
SOCIAL WORK															
SOCIOLOGY															
Times Cited	114	72	51	46	44	36	32	32	28	27	27	23	23	22	19

Table 1. Research focus of papers in topic DL
Source: own

Title of journal	IF	Paper
BRITISH JOURNAL OF EDUCATIONAL TECHNOLOGY	1.887	1, 12
COMPUTERS & EDUCATION	3.771	4, 5
EDUCATIONAL TECHNOLOGY & SOCIETY	1.472	6
IEEE TRANSACTIONS ON LEARNING TECHNOLOGIES	1.608	15
INTERNET AND HIGHER EDUCATION	3.599	2
JOURNAL OF COMPUTER ASSISTED LEARNING	2.437	7
JOURNAL OF EDUCATIONAL RESEARCH	1.641	8
JOURNAL OF SOCIAL WORK EDUCATION	0.817	9, 11, 13
LEARNING AND INSTRUCTION	4.988	3
LEARNING MEDIA AND TECHNOLOGY	1.531	14
TEACHING SOCIOLOGY	0.868	10

Table 2. List of journals of papers in topic DL
Source: own

The authors' activity of the set of paper results one author (or author group) to one paper. The only one exception is author Thyer, BA (paper [11], [13]).

3. TOPIC SIMULATION

Topic Sim has the most WoS indexed articles (369091) of the three analysed topics, and these articles are also the maximal cited (81696). Sim is a topic including the active authors with closed, but intensive research orientation. The most cited is the paper [16] (8056) and the least cited is the paper [30] (3527) of this section. The research focus of the Sim articles is in Tab. 3, list of journals is in the Tab. 4. The content of most articles in the section Sim is oriented to chemistry and physics, some articles are multidisciplinary. The oldest article is from year 1977, the youngest from year 2009; the average year of all articles in the section Sim is 1996.

Science ⬇ Number of paper ➡	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
COMPUTER SCIENCE															
ECOLOGY															
CHEMISTRY															
MULTIDISCIPLINARY															
NUCLEAR SCIENCE															
PHYSICS															
Times Cited	8056	7439	7392	6842	6203	5945	5420	4913	4821	4551	4372	4178	4044	3993	3527

Table 3. Research focus of papers in topic Sim
Source: own

Title of journal	IF	Paper
JOURNAL OF COMPUTATIONAL CHEMISTRY	4.648	24, 30
JOURNAL OF CHEMICAL THEORY AND COMPUTATION	5.756	20
JOURNAL OF MOLECULAR MODELING	1.508	26
JOURNAL OF PHYSICAL CHEMISTRY	4.173	29
JOURNAL OF PHYSICS-CONDENSED MATTER	2.199	21, 22, 23
JOURNAL OF THE AMERICAN CHEMICAL SOCIETY	12.376	16, 25, 28
MOLECULAR ECOLOGY	6.232	19
MOLECULAR PHYSICS	1.607	27
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS ...	1.102	18
PHYSICAL REVIEW B	3.513	17

Table 4. List of journals of papers in topic Sim
Source: own

The authors' activity of the set of paper represents one author (or author group) to one paper. There are four exceptions: author HESS, B. (paper [20], [24], [26]); van der SPOEL, David (paper [20], [26]); KOLLMAN, PA. (paper [25], [30] and WEINER, SJ. (paper [25], [30]).

4. TOPIC COMMUNICATION

Topic Com has the middle WoS indexed articles (165934) of the three analysed topics, and these articles are also the middle cited (52390). Com is a topic including the active authors with brother and intensive research orientation. The most cited is the paper [31] (12948) and it is the most cited paper of all analysed articles and the least cited is the paper [45] (1329) of this section. The research focus of the Sim articles is in Tab. 5, list of journals is in the Tab. 6. Journals with the highest impact factor of all journals is NATURE (41,458) and CELL

(32,857). The content of all articles in the section Com has more diversity that in other sections. Some articles is oriented to telecommunications, some to engineering or electrical & electronics. The oldest article is from year 1948 (the oldest article of all), the youngest from year 2005; the average year of all articles in the section Com is 1989.

Science ⬇ Number of paper ➡	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
BIOLOGY														■	■
COMPUTER SCIENCE	■									■					
ELECTRICAL & ELECTRONIC		■	■	■			■								
ENGINEERING		■	■	■			■					■			
HARDWARE & ARCHITECTURE	■									■		■			
INFORMATION SYSTEMS				■											
MANAGEMENT									■						
MEDICINE													■		
MULTIDISCIPLINARY						■					■				
NEUROSCIENCES								■							
OPERATIONS RESEARCH									■						
PHYSICS						■									
PSYCHOLOGY					■										
TELECOMMUNICATIONS	■	■	■	■			■			■		■			
Times Cited	12948	6998	5046	4431	3030	2780	2658	2580	2324	2276	1570	1549	1537	1334	1329

Table 5. Research focus of papers in topic Communication
Source: own

Title of journal	IF	Paper
ANNUAL REVIEW OF CELL AND DEVELOPMENTAL BIOLOGY	19.319	45
BELL SYSTEM TECHNICAL JOURNAL	0.438	31, 40
CANADIAN MEDICAL ASSOCIATION JOURNAL	6.910	43
CELL	32.857	44
CLINICAL NEUROPHYSIOLOGY	3.477	38
IEEE TRANSACTIONS ON COMMUNICATIONS	2.192	42
IEEE TRANSACTIONS ON INFORMATION THEORY	2.350	34
IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS	4.149	32, 33
JOURNAL OF AUTISM AND DEVELOPMENTAL DISORDERS	4.263	35
JOURNAL OF THE OPERATIONAL RESEARCH SOCIETY	1.386	39
NATURE	41.458	41
PHYSICAL REVIEW LETTERS	7.326	36
PROCEEDINGS OF THE INSTITUTE OF RADIO ENGINEERS	0	37

Table 6. List of journals of papers in topic Communication
Source: own

The authors activity of the set of paper represents one author (or author group) to one paper. There is one exception: author SHANNON (author in paper [31], [37], [40]). Claude Elwood Shannon (*April 30, 1916 – †February 24, 2001) was an American mathematician, electrical engineer, and cryptographer known as "the father of information theory" [31].

5. ANALYSIS USING TOVEK TOOLS

For the analysis, it is necessary to obtain the source text of papers [1] to [45]. This unfortunately failed, because most articles are not in a full-text version available; see Fig. 1 (only 15 from 45). It is necessary that the analysis is carried out in an integrated environment that is finally made only with abstracts, which are available to all articles.

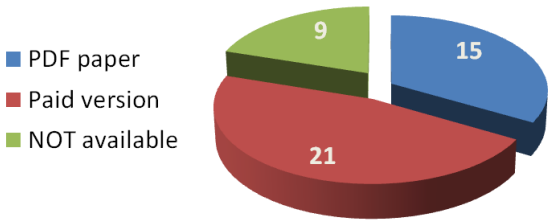

Fig. 1. Papers in full-text availability
Source: own

At first it was discovered whether some of the articles do not include more than one topic of the DLSC conference (DL, Sim, and Com). It was confirmed only in 4 articles ([20], [34], [06] and [08]), see Fig. 2. There are articles with the relevance score to the question of value great than 60. The 41 articles with the score less than 50 includes only one topic of the DLSC conference. The question is written in Tovek language and means that the key words (DL, Sim, and Com) are retrieved with Boolean operator OR, but the result of the query (HIT) is ordered by the score with Boolean operator AND. The Fog. 2 shows the query, its result, and article [20] in Tovek viewer with highlighted key words.

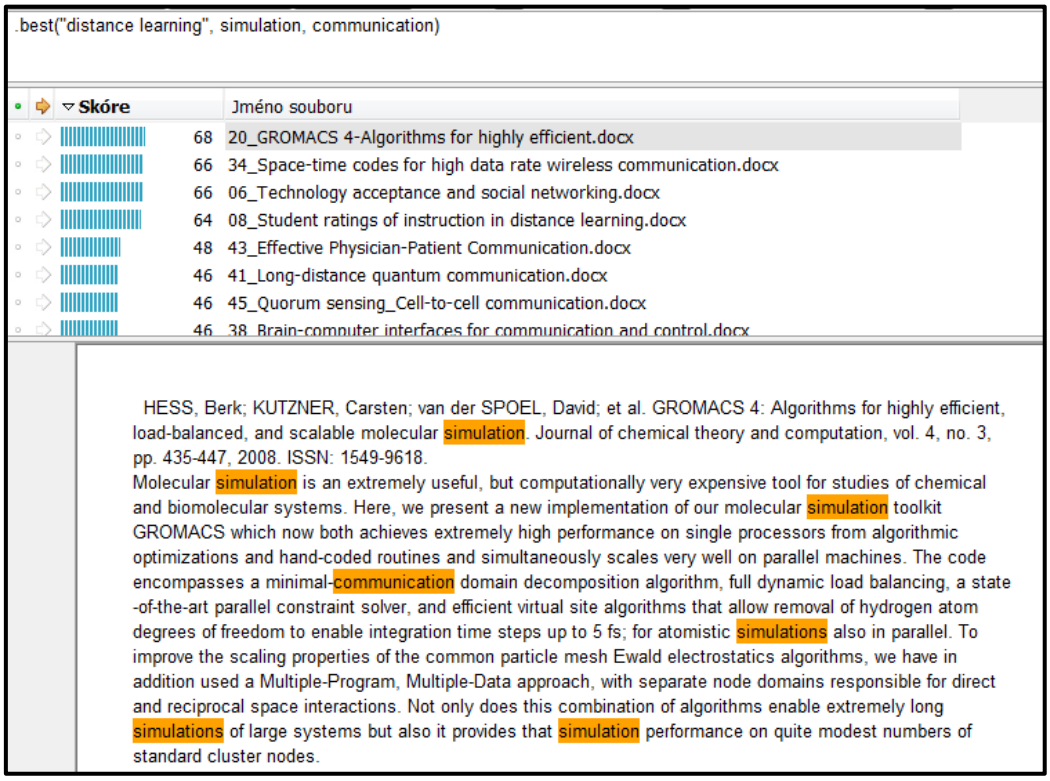

Fig. 2. Articles with more topics of the conference
Source: own

Then was analysed context between papers, using the TT module for contextual analysis. To the topics of the conference were added words that are in authors scientific preference "computer science" (CS,) and "informatics" (Inf). According the Fig. 3, there are only five articles that contain common words from the set of contextual questions. Two articles contain words "Sim and Com" ([20], [34]), two articles contain words „DL and Com" ([06], [08]); and one article contain words "CS and Com" ([38]), see Fig. 4. The word "Inf" is not included in any article of all 45 analysed articles.

The analysis results confirm the validity of the initial hypothesis.

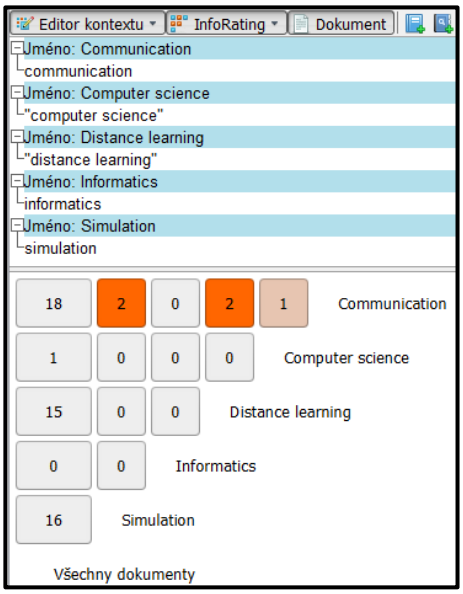

Fig. 3. Context analysis of papers
Source: own

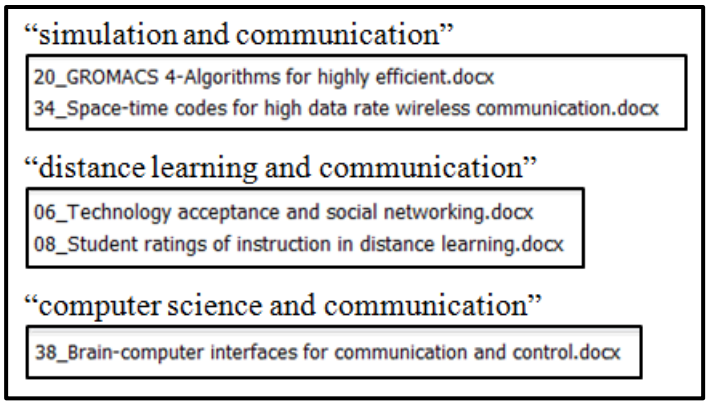

Fig. 4. Papers with context
Source: own

The last analysis, using TT modules, was content analysis that allows finding the detail content of the papers. Result can be depicted in a graph of word connections: for word "distance" (Fig. 5) and for word "learning" (Fig. 6). The value of a link between words in graph determines the "strength" of that connection and between words "distance" and "learning" is relatively high (74).

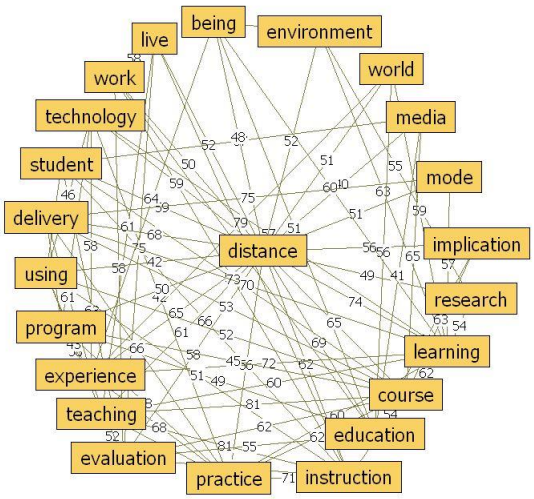

Fig. 5. Content analysis of word "distance"
Source: own

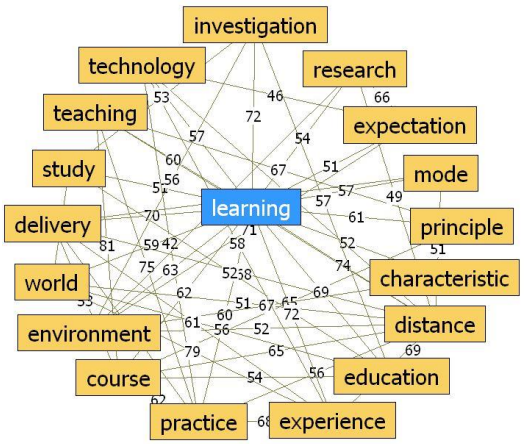

Fig. 6. Content analysis of word "learning"
Source: own

CONCLUSION

The paper is focused to analysis of chosen articles indexed on WoS with topics of the DLSC conference: DL, Sim, and Com. The analysis was carried out in two steps. The first step was oriented to statistics of the topics separately. The second step of analysis was performed with SW TT, was oriented to complex query using words DL, Sin, and Com; and to context and

content analysis of all topics together. The results were depicted in tables and graphs and confirmed the working hypothesis.

The preparation of the article was the author of a very interesting and challenging in applying analytical procedures using the TT, but also very laborious to obtain and modify relevant articles.

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Acknowledgement

The work presented in this paper has been supported by the institutional research in project DZRO209 University of Defence, Faculty of Military Technologies, CIS Department, realized in years 2016-2020.

USING ASYNCHRONOUS DISCUSSION GROUPS TO SUPPORT TEACHING IN HIGHER EDUCATION

Bülent Döş
Gaziantep University, Nizip Faculty of Education, Nizip-Gaziantep, Turkey
bdos@gantep.edu.tr, bulentdos@yahoo.com

Abstract: *Asynchronous discussion groups can be referred also computer supported collaborative learning environment is central to the constructivist learning theory. This kind of discussion groups foster collaborative and social learning. This study was carried out in an undergraduate teaching principles course. The students were asked to read a paper every week and discuss it on Google Groups and Blogs. The aim of this study was to evaluate the usage and effectiveness of these discussion groups in Google groups and Blogs. The data was collected from observation and questionnaire. This study showed that Google groups could be used best for communication and Blogs could be used best for discussion.*

Keywords: Asynchronous Discussion, Google Groups, Blogs, Collaborative Learning.

INTRODUCTION

Information and communication technologies were developed far beyond the expectations. We can see that children from ten years old to older people use smart phones which are connected to Internet. The Internet connection power was increased and prices of Internet connection from mobile phones decreased. These changes led to educators to use this opportunity in their teaching process. We can see that many students use social media such as Facebook, Instagram, Twitter, etc. Students use their mobile phones to connect social media and accept this technological wonder such as their best friend or clothes [1]. Educators found that they can use students' mobile phones in their teaching process outside the classroom. So they created educational blog websites, asynchronous discussion forums or Facebook groups. Online asynchronous discussions with computer and mobile phones through Internet changed the collaborative learning in and outside the classroom. It is assumed, often based on socio cognitive and constructivist theories of learning, that online asynchronous discussions "much learning goes on outside the formal classroom [2]. This is very important for students because especially in Turkey many university students don't study their lessons regularly. Asynchronous discussion forums force students to study lessons and reflect their learnings outside the class. These forums also provide opportunity to students to study collaboratively outside the class environment, without time and location limit [3]. This feature of online discussion forums also very important because many students don't communicate or interact with their classmates even they pass three or four years. These online discussions give opportunity to students to communicate and collaborate each other [4]. Blogs are also used to foster learning, reflecting ideas, enable easy communication and collaboration among university students. Blogs are also important communication tools that they can take the learning outside the classroom and provide opportunity to students to learn collaboratively. Google Groups offers at least two kinds of discussion group; in both cases users can participate in threaded conversations, either through a web interface or by e-mail [5]. Google groups and Blogs are used as communication, collaboration, learning and reflecting tools in this study. The aim of this study was to reveal the usage and effect of the Google groups and Blogs about reflecting ideas, communicating, collaborating and learning in higher education.

Many studies, have reported on positive effects of asynchronous discussions, but they have largely adopted the perspective of the course instructor, who evaluates the quality of students' contributions to electronic discussions. Fewer studies have focused on the perspective of the students, and this study is mostly evaluated the students insights about these discussion groups.

1. ASYNCHRONOUS DISCUSSIONS AND BLOGS

Discussion forums were used to reflect the class learnings, communicate and collaborate. Research on the use of asynchronous technologies in general has found that they enhance learning for students in that they provide structured opportunities for students to engage with course material [6-7-8]. Benefits of asynchronous discussions also include opportunities to think about course content and to address a diverse set of topics in more depth than can be done in class or in a synchronous environment, thus allowing students to conceptualize a topic from multiple viewpoints and to contribute to each other's understanding [9-10-11]. Asynchronous discussions allow students, in groups, to collaborate with each other in an exchange of opinions, experiences, and interpretations of course content.

Blogs also were used to reflect the ideas learnt from lessons and also collaborate by writing comments in blog postings. Blogs are being increasingly used in higher education [12]. With the increased use of blogs, various research studies have been conducted to investigate effects of blogging on students' learning [13-14-15]. Previous studies show that blogs can enhance reflective thinking [16] deeper learning and knowledge construction [17].

1.1 Google Groups

Google Groups is a web application provided by Google (https://groups.google.com/). By entering this website, you can create four different types of groups. The first is e-mail list group where you can send e-mails from groups and from email to the group members. The second is web forum where you can create an interactive discussion on the website and members can reply to the discussions with this website. But the updates will come to their emails. The third is question-answer forum where you can ask a question and members can vote it, questions can be marked as answered. The postings should be sent by webpage, not with e-mail. But the updates are received by e-mail. The last type of group is collaborative work group where you can allocate some subjects to members. You can change the allocation settings. Google groups support many languages including Turkish. This is very good option because many of our students don't speak English. The researcher created a Google group with the first type (https://groups.google.com/forum/#!forum/nizip-ozel-ogretim-yontemleri-2017) to send and receive e-mails when it is posted. It can be seen a screenshot of the Google Groups page in Fig. 1. This was the screenshot of the 3.article sent to the group that students had to made comments on it.

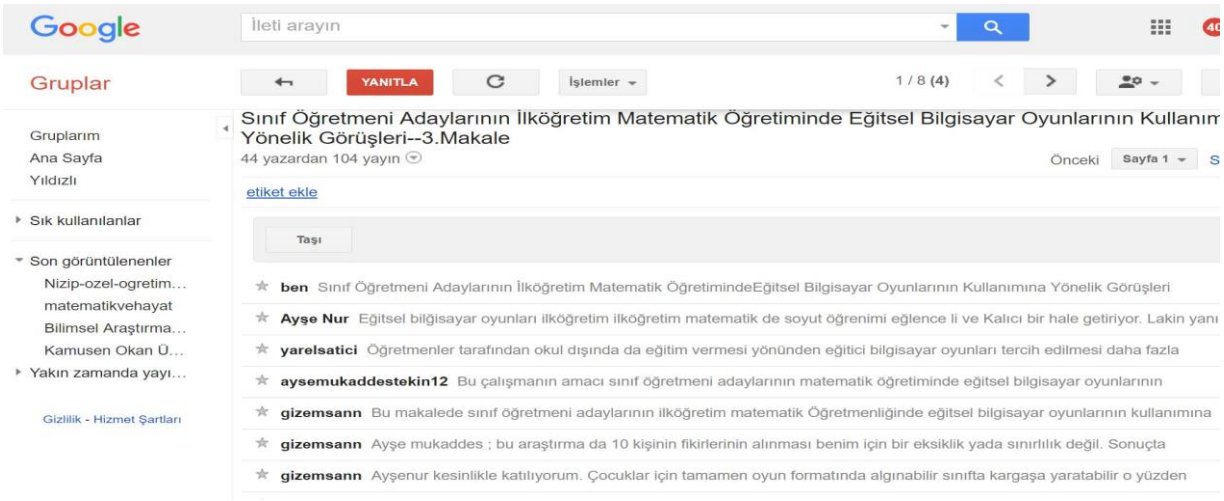

Fig. 1. A screenshot of Google Groups Page
Source: own

1.2 Blogs

The researcher created a blog website (http://nizipozelogretim.blogspot.com.tr). Creating a blog web page is very easy and quick. If you have a Google account, you enter the web site blogger.com and create a blog website where you can post anything you want. This blog website provides opportunity to the blogger to publish come postings, and the reader can comment on about postings. Also the website shows the latest postings in the main page. The postings are archived according to their time published. This kind of personal websites are very useful for education. Students can create their websites and put their products and the other students also can comment on their postings. These websites are accepted as digital portfolios where you can monitor the students. In this study the researcher published the post in the course blog website and asked to the students to comment on the post. The postings were articles about the subject students had to read. After reading the article every student had to comment on article.

Fig. 2. Blog web page
Source: own

Blog web page was used to show articles and make comments about the subject. Last four weeks all the comments were done within the blog web page (Fig. 2).

2. METHOD

This study is carried out within qualitative settings and this is a case study. The students were asked to write their comments and reflections in Google Groups (4 weeks) and Blog website (4 weeks). The students were guided with e-mails online and with talking in face-to-face sessions. The students also informed that their postings will be graded, and so all students continued their comments regularly. Totally 34 students (23 female, 11 male) continued to the course and postings. The researcher gathered data by observing the Google groups and Blog websites. The researcher also gathered data from students with semi-structured questionnaires. The data was analyzed with content analysis method.

3. FINDINGS

The researcher used Google groups to get immediate information about who commented about the post. When a student comments about the article, the instructor and the group members receive e-mail that some other member commented about the article. So without time consuming every people within group can read the comment and reply to this comment if they want. This kind of group activity give unique opportunity to the members that they can follow the discussions almost in real-time. According to the observation of the researcher, students had difficulties how to post their comments to the group in spite of instructor showed how to do it. But majority of the students managed to send their postings to the group. By the weeks passed the students managed to post more comments on selected subjects. We can see the graphic of the number of posts according to the weeks (Fig. 3).

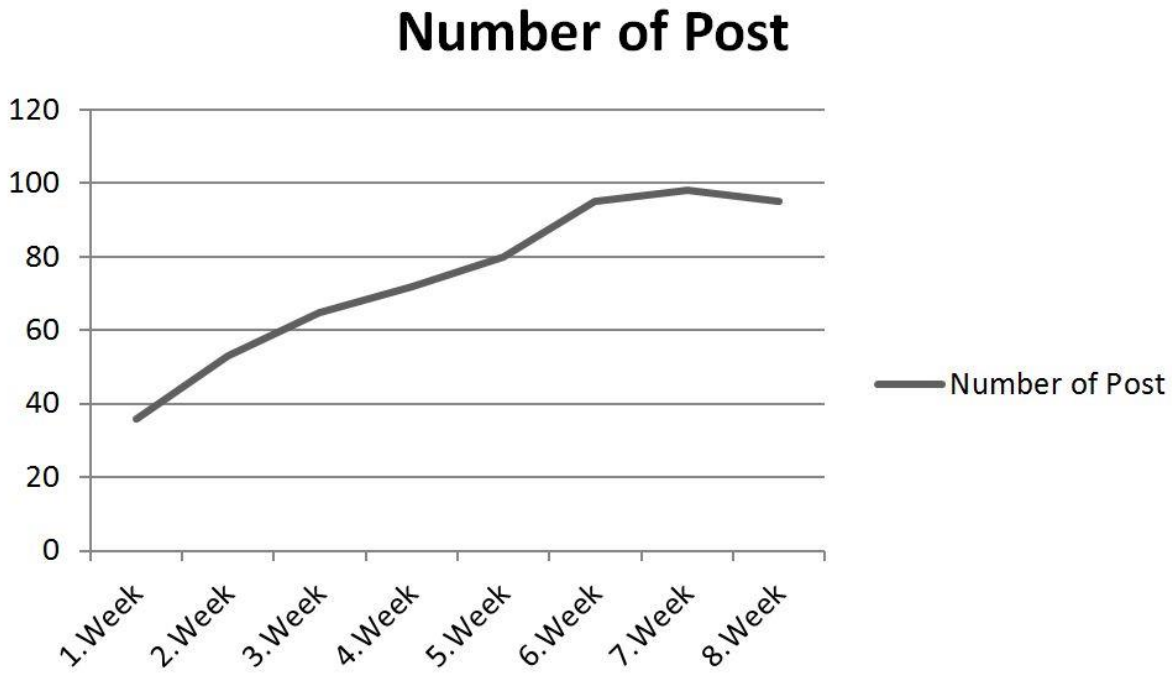

Fig. 3. Number of posts according to the time
Source: own

We can see from the figure that by the time passed, students could be able to send more messages to the discussion. Also we can see that after 6 week, the number of post is continuing constantly about 100 posts a week. This was their first experience to be member an online group and they liked it because they can communicate with their friends outside the classroom. The students also liked to read and send the postings from their mobile phones, all the students in this study had smart phones which they can connect to the Internet. The second data collection method was questionnaires. After analyzing the data advantages and disadvantages of the groups and blogs were emerged like below the table.

	Google Groups	**Blog website**
Advantages	Communication (15) Notifications (12) Accessibility (9)	Communication (14) Accessibility (10) Commenting (8) Easy to use (5)
Disadvantages	Easy to use (11) Commenting (8) Time consuming (3)	Notifications (7) Time consuming (3)

Table 1. Advantages and disadvantages of the Google groups and Blog
Source: own

As we can see from the table Google groups and Blogs have advantages and disadvantages. Students mostly liked the communication features of the groups and blogs. Students can follow their courses outside the classroom and can communicate with their instructor and with their friends. One of the participant stated *"When some students commented, I can see it on my mobile phone and read it easily and learn what my friend think about the article".* This is really very good learning opportunity for students, because this is a group activity and they can learn from others and this kind of learning is more permanent. Students liked the notification of email with Google groups. One student implied that *"It is very nice to get the notification when someone commented on groups, so we can see the comments immediately".* This option really was very good for online learning. When someone writes something on group, everybody is informed by email. This makes the asynchronous group like synchronous. So the synchronous learning makes learning better, because of the immediate feedback and correction. Accessibility from mobile phones both groups and blogs were the best part of this study because many students don't have personal computers. They all have smart phones and they can reach the learning content from their mobile phones without the constraint of location and time. One student commented *"I don't have computer, I only have mobile phone and it is great that I can reach to the course content from my mobile phone wherever I want. I can also comment from my mobile phone to the postings. If this was not available I wouldn't do my task".* We are all living in a digital age, and digital learnings will be heavily on the mobile phones in the future. So it is very useful of Google groups and Blogs to reach from smart phones, to read, to comment postings. The students mostly found Blog website easier than Google groups. One student indicated that *"Writing to the blog was easier than Google groups, because I can understand it easily".* Students liked the blog more than Google groups. We can say it is because they are accustomed to the websites more than e-mail list groups. E-mail groups are not widespread than blogs. One advantage of the blog was commenting section. When a student wanted to comment to the other student's posting, it is not written under the comment section, it is written as a main comment. But in the blog website each student can comment on to a specific student. This feature was better for understanding the commenting. Lastly students found this kind of learning activity time

consuming because they state that face-to-face activities was enough. Because all the students were reaching to the content from their mobile phones, it is not very easy to write long comments with smart phones and read the articles. It will be easy to read and write from desktop computers because the screen is bigger and writing from keyboard is easier than writing from mobile phones.

CONCLUSION

This study was carried out eight weeks and it was understood that the first week of the activity should be introduction and there must be a videos explaining how to comment on articles on Google groups and Blogs. The researcher only showed everything in face-to-face session and some students didn't understand and they didn't tell it to the instructor. Also some students didn't participate to the lesson and they didn't learn from but they learnt from their friends. These students who came lately didn't really understand how the procedure is carried out. The instructor gave extra lesson about it. So it is understood that, the procedure and all the technological activities should be made with video and students must watch it whenever they want. This study showed that both Google groups and Blogs could be used for educational purposes. Turkish university students are not accustomed to the e-mail discussion groups, that why they liked Blogs more than groups. But Google groups have immediate feedback who commented to the postings. Blogs are considered better because it has a user-friendly interface also it is seen as a webpage which all students watch hundreds of webpage in Internet. Asynchronous discussion also has advantages such as giving time to think, review the posting [18-19]. Teaching and learning is also a communication process and it is very important for learning. Because communication in learning process helps students understand topics easier, get immediate feedback and correct the misunderstanding, to ask questions and get answer. Computer supported technology such as Google groups and Blogs provides opportunity to learners to communicate with learners and instructors in class and outside of the class with no time constraint [17]. Google groups and blogs are free to use web applications. This was the best benefit of this technology, because many useful applications are very expensive to use. These applications provided by Google are free, easy to use and useful applications every teacher can use in their lessons to support teaching. This study was a case study about Google Groups and Blogs only, so our conclusion is only for this kind of technology. This technology is free and easy to use, every person who have basic computer skills can create a Google groups and Blog web page and communicate with others.

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MEANS OF CPDLC USING WITH ATC PROCEDURES IN TERMINAL MANEUVERING AREA

Stanislav Ďurčo, Jozef Sabo, Róbert Rozenberg and Žaneta Miženková
Technical University of Košice, Faculty of Aeronautics
Rampová 7, 040 01, Košice, Slovak Republic, stanislav.durco@tuke.sk, jozef.sabo@tuke.sk

Abstract: *The paper deals with practical simulation of air traffic control situated in terminal maneuvering area of Kosice airport. To reach desired results, there was designed a software application for data link communication simulation (DLCSim) which allows direct connection between controllers and pilots. DLCSim is based and meet the conditions set by EUROCONTROL organization. The work focused on searching appropriate way to place CPDLC system and his usage in dynamic environment of arriving and departing traffic. Frequent consultation with expert from EUROCONTROL organization, air traffic controllers and technicians working for Slovak Air Traffic Services, and pilots operating on airplanes like B378, or ATR 72-600 on regular basis, make this experiment as close to the reality as it is possible.*

Keywords: CPDLC (Controller–Pilot Data Link Communications), data link, voice communication, frequency congestion, flight simulation, TMA (Terminal Manoeuvring Area), ATCO (Air Traffic Controllers).

INTRODUCTION

Today we can see expanding airspace of free route navigation with step by step implementation of data-link communication within the Europe also known as CPDLC. This new type of communication went through a years of research and development and is slowly becoming the part of routine communication between air traffic controller and pilot. Increasing traffic is not only issue of area controlled airspace, but also significant problem within terminal maneuvering area (TMA). This dynamic environment creates huge frequency congestion preventing active control of inbound and outbound traffic. The need of voice communication replacement is growing every day with persistently blocked frequency, repeating long messages, and with occurrence of dangerous wrong readbacks and hearbacks.

Air traffic controller has to correct the wrong acknowledgements and repeat messages, what only leads to increased frequency congestion. The capacity of voice communication is very limited in today's traffic density. The intense workload has become unthinkable part especially on air traffic controller’s site. Reduction of TMA Frequency Congestion Using CPDLC is real time simulation.

1. SIMULATION OBJECTIVE

The simulation was performed on the Faculty of Aeronautics, Technical University at the Department of flight training in cooperation with the Department of avionic system in resolving tasks of Student Scientific activities of the student's final works.

The main objectives of the simulation were to assess existing procedures in communication between air traffic controllers (ATCO) and pilots in the approach phase of flight, the impact of using data link (D/L) communications and new procedures on traffic flow, and the air traffic controllers and pilots overload with respect to mutual communication. All simulation procedures and software application (DLCSim) developed for such purposes were developed based on EUROCONTROL requirements.

Objectives were specified for general use of data link communications for procedural control as follows:

- Reduce number of orders
- Define common errors
- Eliminate errors using D/L
- Create user friendly environment software application for ATCO
- Create electronic only environment
- Identify usage of combination of voice and D/L communication
- Compare congestion using voice and D/L communication
- Added objectives for pilots:
- Research congestion for pilots using D/L
- Measure time needed for response.

For the simulation was chosen Kosice International Airport with connections to multiple countries like Czech Republic, England etc. The airport is situated in the east of Slovakia, approximately 6 km south of the city center. Procedural control requires different procedures and separation minima than radar control that is why it is not possible to use all of standard terminal control areas, standard arrival and departure procedures as well as STAR and SID charts. So in order to proceed with simulation, I have developed slightly different new arrival and departure procedures based on actual ones. New procedures and charts were created with minimum changes to the actual ones.

2. EXPERIMENT

The objective of this experiment was to compare congestion and flexibility of voice communication and communication provided by data link system. Experiments were based on exercises created for Košice Airport using data collected from real traffic situated in the airport and around its area.

There were four controllers and three pseudopilots who took part in five exercises, both with voice and data link communication, but the last one. That makes total number of 36 exercises executed. In the last exercise controller had been asked to use data link communication, and when he feels that he needs to use voice he was able to proceed in chosen way. Exercises had growing trend, so participants could settle in and get used to new application software and its interface. DLCSim was also partly developed by adapting to requirements from participants point of view and suggestions, improving controllers interface and application software overall efficiency. All exercises were recorded and stored, both voice and data link messages records.

The traffic was based on real airplanes we can find flying to and from Košice Airport. For example can be named airlines as: Wizzair, Austrian Airlines, Travel Service, or CSA. In exercises is also included non real traffic, so congestion could grow in time and simulation

could lead to satisfying results. For pseudopilots were prepared document (pilot log) made in Excel.They were able to report at any time information requested by ATCO, easily react to commands and adapt to new situations.

For the purposes of this experiment was developed software application (DLCSim) to simulate all data communication between ATCO and pilots. This version allows sending the messages important for ATCO-pilot communication which was defined by EUROCONTROL in Link2000+. DLCSim provides also actual METAR data for specified airport where ATCO is connected to. The whole graphical user interface (GUI) is designed to meet EUROCONTROL requirements for human-machine interface (HMI) for ATCO and pilot workstations. DLCSim consists of two main modules: ATC Module and Pilot Module.

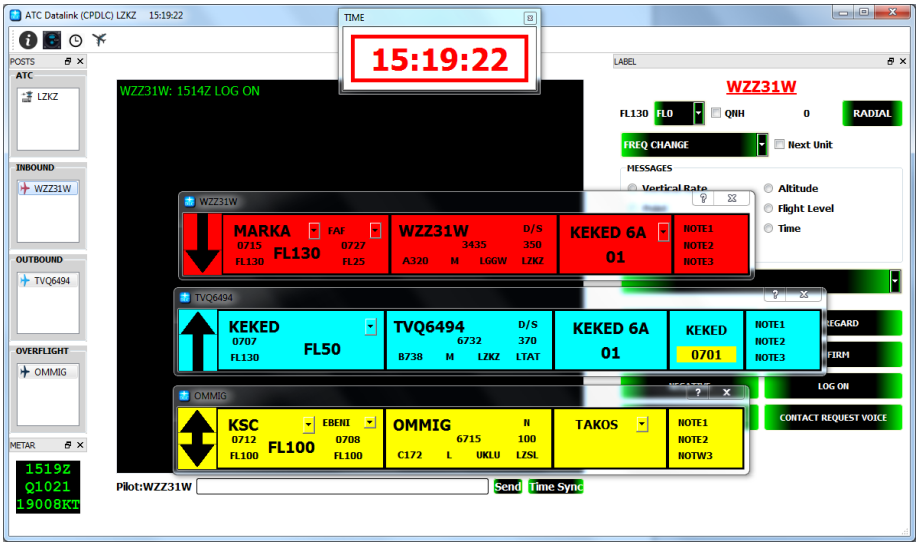

Fig. 1. DLCSim ATC Module
Source: own

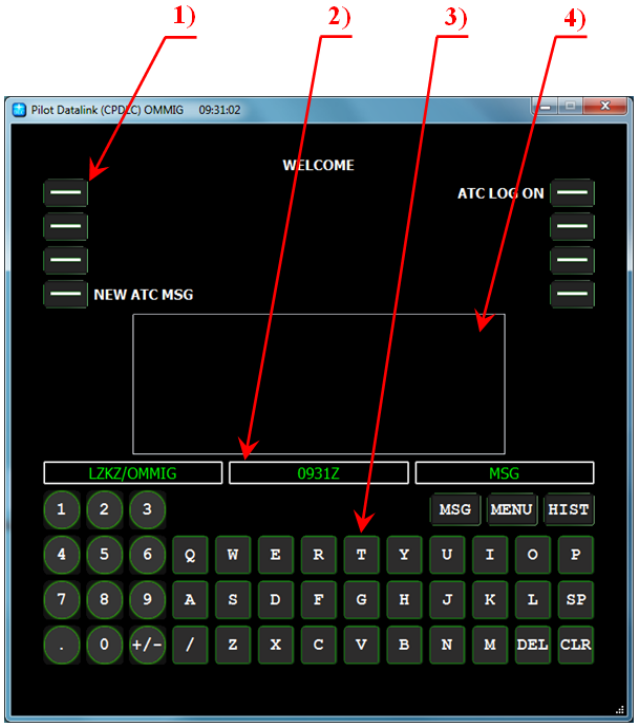

Fig. 2. Pilot Module
Source: own

One of the greatest concerns was losing situational awareness while using data link. But as soon as controllers get used to work with DLCSim application software, they managed to name exact airplanes location with the same precision while using voice communication. There was recorded non difference in situational awareness between voice and data link communication, while giving orders for pilots.

3. RESULTS

If we look at the parts like log on or log off messages, or for example clearance for ILS approach, data link communication is by considerable amount time-saving and it is reducing controller's workload. At the other type of messages, controllers seem to spend equal, or more time using D/L. Orders for climb, descent, or requesting information from pilots actually slightly increased the controller workload.

During the exercise appeared messages from pilots without any direct order from ATCO. For example reports like passing points, crossing, or reaching cleared flight levels, or after crossing transition level reaching cleared altitudes. This type of messages cut in average almost 11 % from total exercise time. This amount is significant and can be reduced by using data link communication to minimum of voice frequency congestion. After realizing there is no need for confirmation of the message received when using data link, controller workload is minimal.

The last exercise was created to simulate the possibility of combination the voice and data link communication. Controllers had the possibility to choose which messages to send by data link as priority communication and which massages to send by voice. The exercise was more difficult than they have had experienced from the beginning of their procedural training. With the raising experience with DLCSim software application controllers manage to complete this difficult exercise with no significant problem, all by using data link communication.

Even though, from statistics, experiences and personal interviews the best way is to use combination of both voice and data link communication.

Communication is a two-way process that is why research only in the environment of air traffic control is not enough. Cockpit crew is going through a lot of work and procedures during the approach phase. Another increasing workload for pilots is using voice communication. Not only the pilot has to be always on gourd for call from controller, but there is always a place for misunderstanding or miscommunication. Repeating the same message is only leading to enhanced frequency congestion. Much worse situation could happen, if pilot or controller misunderstands each other, what could lead to loosing separation minima or accident. Data link system in cockpit has not only potential of reducing pilot's workload, but also is removing the possibility of miscommunication between controller and pilot to minimum. Human influence is still a factor, but its impact is reduced by significant number.

For the research, pilots performed several flights on B58 flight simulator using only data link communication. The crew was created from one pilot and one copilot to simulate standard crew configuration. These flights were focused on pilot's workload, when using data link communication, while they went through all standard procedures necessary for arrival or departure.

During the flight pilot and copilot were subjected to greater amount of messages than we recorded from controllers exercises, so their workload could be tested on higher level. Reaction time of pilot handling communication was better than expected with positive reaction from the whole crew. The standard report messages or direct orders have met with reaction time from 9-12 seconds. More complex messages or combined messages increased crew's reaction time to 15-20 seconds. In simulated exercises were not tested any non-standard, nor emergency messages.

In many situations pilots favor data link over the voice communication. Cockpit crew does not need to listen to all communication on frequency, just wait for audio signal when message had arrived. At this time, voice communication should be still used as primary communication and data link can support it as a backup, or its replacement at some stages of flight. According to pilots, data link has potential to become primary communication, and voice communication would be provided only in non-standard and emergency situations.

CONCLUSION

This experiment should give an answer to the question, if pre-formatted messages would decrease the voice communication usage. After the evaluation, the controllers agreed that it could bring decrease to voice communication congestion. As concluded from experiment final acquired data, broadcasting the information like log on, log off messages, or clearances for ILS approach might save channel usage by significant amount of time. However in other cases, exceptional situation and unexpected events are not the main concern of the voice communication congestion, thus pre-formatted messages and data link communication is not the solution for that kind of problem, but only creates more workload for controllers who would have to manage them.

All controllers acknowledge the data link as easy to use, time saving and safety increasing tool. After personal interviews all of them agreed that data link could be used as a secondary communication channel for standard messages increasing flight safety and controllers capacity. The data link communication proves itself as a tool for significant decreasing voice communication congestion and reducing controller´s workload. All controllers confirmed that in specific situations, data link is giving them additional time for solving other problems connected with airspace control.

Using data link communication requires greater attention and more anticipation according to the transmission delay when sending message. Nevertheless data link was found as a promising tool even in the as dynamic phase as is the approach and departure phase.

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MODERN MOBILE TECHNOLOGY IN EDUCATION

Rostislav Fojtík
University of Ostrava
Ostravská univerzita, 30. dubna 22, Ostrava, Czech Republic, rostislav.fojtik@osu.cz

Abstract: *The current development of computer technology brings new demands on the use of computers. Users increasingly prefer mobile devices instead of desktop computers. Mobile devices are also promoted in the classroom. Students use mobile devices not only for entertainment but also in their studies. The aim of this paper is to show the results of a questionnaire survey. The survey shows how students use mobile devices. The survey was conducted among primary and high schools and among university students. Another aim is to introduce the types of mobile devices and their potential use in teaching. Mobile technologies are changing the approach to e-learning. These technologies help students and teachers.*

Keywords: education, mobile devices, mobile technology, research, questionnaire.

INTRODUCTION

Mobile technology is currently developing very rapidly and is involved in all aspects of life. Devices such as smartphones, tablets, notebooks, convertible devices, smart watches, and other readers, uses a large portion of the population, including children. Mobile devices represent a breakthrough in the use of computers and require a new approach. Greater emphasis is placed on the use of cloud services and data synchronization with other devices. Previously, users tended to have all the data on the internal storage of the computer [1] [5].

Internet usage by mobile and tablet devices exceeded desktop worldwide for the first time in October 2016 according to independent web analytics company StatCounter. Its research arm, StatCounter Global Stats finds that mobile and tablet devices accounted for 51.3 % of internet usage worldwide in October 2016 compared to 48.7 % by desktop [6].

When working with mobile devices, it is preferable to use mainly cloud services and devices are widely becoming only kind of terminal that accesses the individual data and services. The user was a few years ago fundamentally limited to a specific device and most of the data formats to be able to view and edit only on desktops or laptops. Current smartphones, tablets and other mobile devices allow you to work with documents of all formats, access, and edit any data. All data can be synchronized and the user has access to their information from any device. Users can check their tasks and appointments, view documents requested, work with multimedia data anytime and anywhere. Many mobile devices are becoming fashionable and trying to own the latest tablet or smart phone is noticeable not only among adults but also children. In education and training also addresses the development of mobile computing [3]. It is developed by the amount of mobile educational software, increases the effort and the pressure on the classification of these modern means of teaching. Teachers are experimenting with the use of mobile devices in the classroom. Increasingly frequent are noticeable efforts across the board to introduce mobile devices into education [7] [2].

1. THE SURVEY OF MOBILE USAGE

We did a survey of relationships between teachers and pupils to mobile devices. As a basic method was used questionnaire. The questionnaire was completed by 39 teachers. 15 of them teachers teach Informatics and Computing. Other respondents of the research were 138 students aged 11 to 19 years. Among teachers, 56 % were women and 44 % men. The average age of teachers is 40 years; the average age of students was 15 years. Among the students were 67 % of boys and 33 % of girls.

A third group of respondents were students of bachelor degree Computer Science. Full-time students were 28. Men were 22 and women were 6. The average age of full-time students was 21 years old. Distance students were 24. Men were 17 and women were 7. The average age of full-time students was 33 years old.

1.1 The methodology

Teachers filled out a paper version of the questionnaire, which contained 15 questions. The questionnaire contained content items, but also functional items, specifically items contact and control. Most of the items of the questionnaire were closed or semi-closed structured entries. Questionnaires were sent out, but the individual respondents were personally sought to fill, to ensure a full return. Pupils received an electronic questionnaire with ten items. The evaluation of the data obtained were used statistical methods. Bachelor students completed the electronic questionnaire. The questionnaire included six closed questions. The aim of the survey was to determine what mobile devices students use. For analysis of the results in each item was measured as having detected data variability. We used a coefficient of variation. To interpret the results of the second stage classification was done chi-square test [4]. For evaluating the results were used MS Excel and statistical software Wizard for the operating system on Mac OS X and statistical software Statistics Visualizer for iPad.

1.2 The results

Teachers and pupils were asked whether they think that mobile technology can help them in the classroom in elementary and high schools. 85 % of teachers believe that mobile technology can help them prepare for courses in teaching itself. The opposite holds only 5 %. 10 % cannot assess it. Pupils have similar results: 86 % of students believe that mobile devices can help them in the classroom, 9 % think the opposite and 4 % cannot assess it.

The following graphs show some of the survey results. Teachers are divided into two groups. The group of teachers of informatics and the group of teachers of other courses.

Predictably, teachers and pupils use most laptops, tablets and smartphones. Respondents cited as other mobile devices e-book readers. Convertible devices, smart watches and wearables are used on a small scale so far. Predictably, teachers and pupils use most laptops, tablets and smartphones. Respondents cited as other mobile devices e-book readers. Convertible devices, smart watches and wearables are used on a small scale so far.

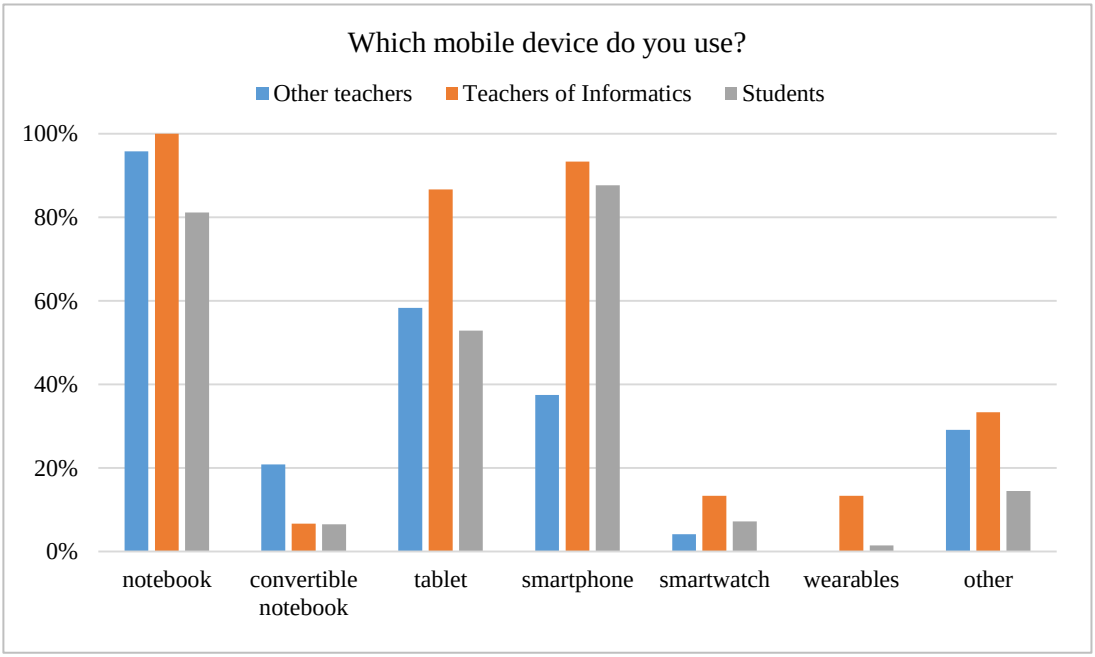

Fig. 1. Which mobile device do you use? Elementary and High schools
Source: own

The second graph shows the responses bachelor students. These results are like those in the first graph.

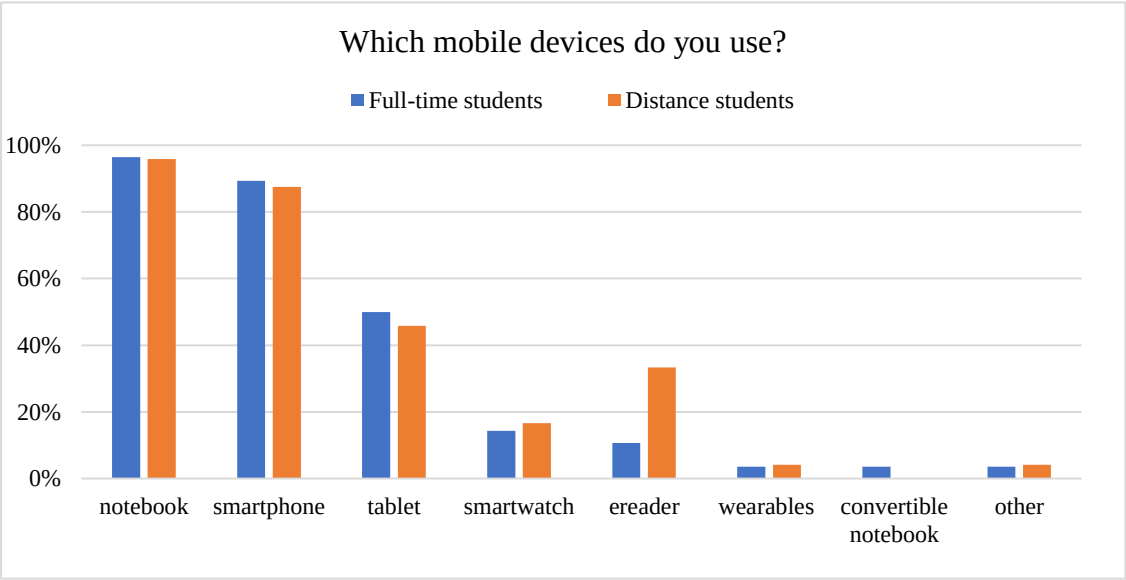

Fig. 2. Which mobile device do you use? Bachelor's degree
Source: own

Pupils on their devices most commonly used mobile applications for social networking, Web browser and mobile games. The graph in Figure number three shows how students lined up mobile application, depending on how frequently and intensely used.

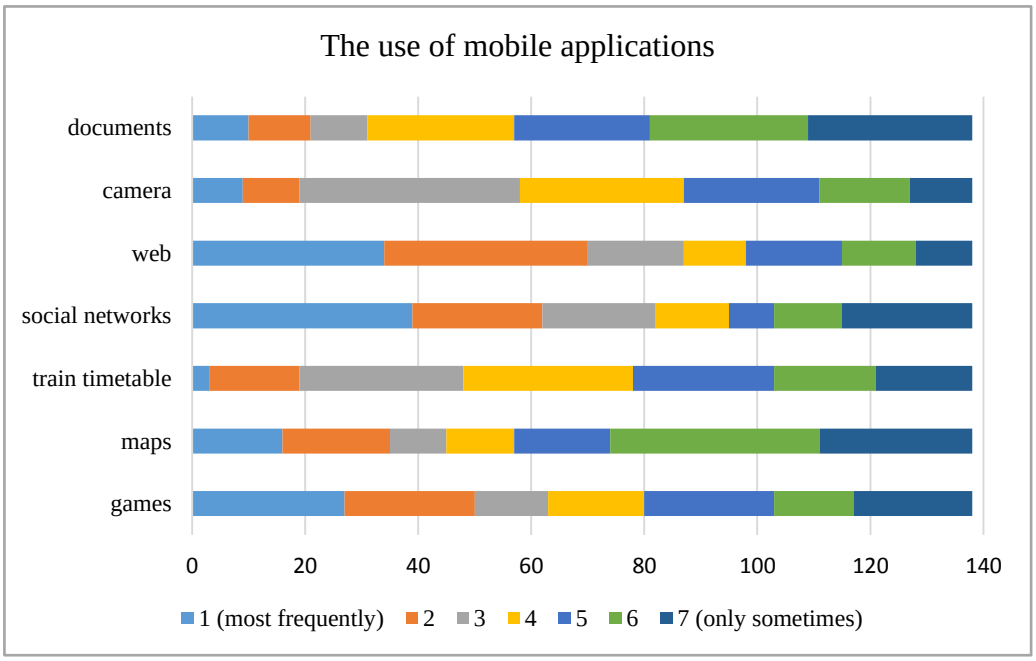

Fig. 3. The use of mobile applications
Source: own

The graph in Figure number four shows how students use mobile Internet access. Results of full-time students bachelor's degree and pupils from elementary and high schools are very similar. Distant students benefit less mobile access to the Internet. This fact is probably connected with the age of respondents.

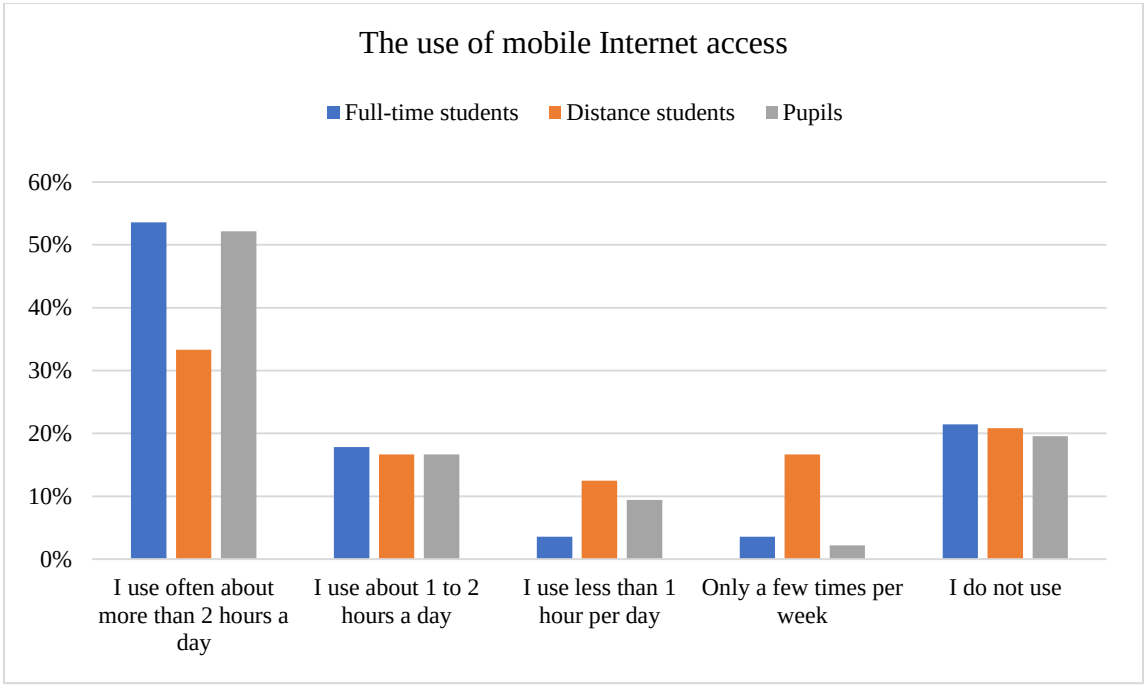

Fig. 4. The use of mobile Internet access
Source: own

We created several hypotheses:
H1: Teachers of Informatics use mobile computing devices better and more often than teachers at other approbation.
H2: Teachers use better abilities of mobile devices than the students. Teachers use even more cloud services.
H3: Students use mobile devices for gaming and social networking.
H4: Full-time students use mobile technology more than distance learners.

The testing of hypotheses was used statistical methods for analysis of nominal data, specifically the chi-square test. Were first formulated null and alternative hypotheses were calculated expected frequencies and test criterion, which was then compared with a critical value. At a significance level of 5 % can be stated veracity hypothesis H1. Conversely H2 hypothesis cannot be confirmed. For a verification of a third hypothesis was found that students use mobile devices for other purposes than just games and access to social networks. Hypothesis number four has not been confirmed.

Modern mobile technologies require a new approach. Previously, it was very important what the user computing device used. Kind of device very limited scope and method of working with data. At present, the computer is usually used as a terminal for data access. Users can get their data not only from the desktop, but also a tablet, smartphone or other mobile device. A user who wants to unlock the power of mobile devices must actively use cloud services. Other charts show how often respondents use cloud services [8] [9].

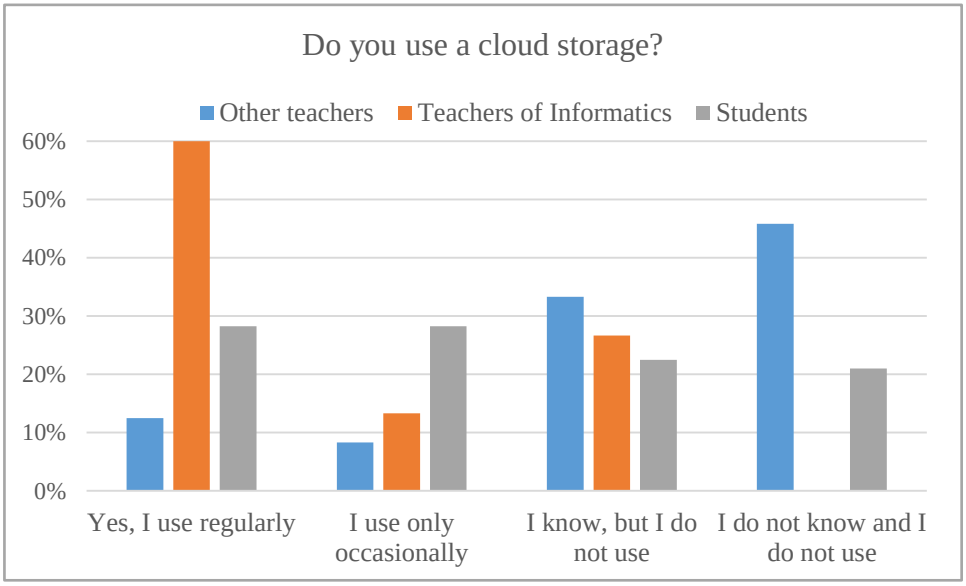

Fig. 5. Do you use a cloud storage? Elementary and High schools
Source: own

Results of the questionnaire survey show that the use of cloud technologies is not sufficient. Information is needed about these technologies get into teaching. We've analyzed the 32 thematic plans for curriculum of informatics at elementary and high schools. Only two, we found signs of possible teaching cloud technologies. Thematic plans contain no mention of mobile technologies. Teachers still focus only on teaching control desktop applications.

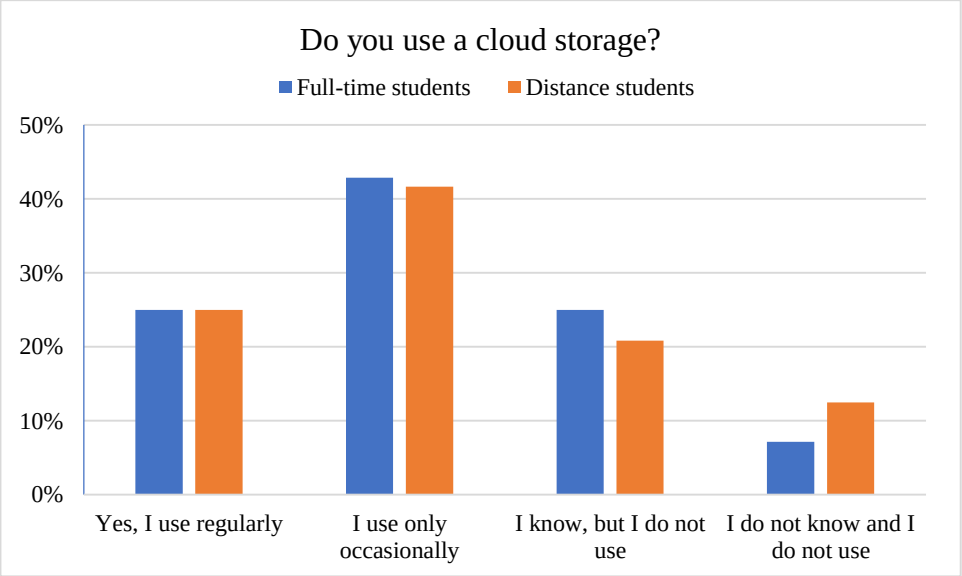

Fig. 6. Do you use a cloud storage? Bachelor students
Source: own

CONCLUSION

Mobile computing technologies require users to change their approach to the use of these devices and more work with cloud services and data synchronization among devices. A survey among teachers and pupils showed that mobile devices are widely used and exploited. Teachers other than those qualified informatics is not used and do not know many of the important possibilities of using mobile technology. It is necessary to make teaching more focused on mobile technologies and cloud technologies. Pupils must learn these new technologies properly used. Teaching should not focus only on desktop systems.

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MATLAB2WEB – PUBLISHING MATLAB FUNCTIONALITY TO THE WEB

Miroslav Gula and Katarína Žáková
Faculty of Electrical Engineering and Information Technology
Slovak University of Technology
Ilkovičova 3, 812 19 Bratislava, Slovakia
miroslav.gula@stuba.sk, katarina.zakova@stuba.sk

Abstract: *The paper presents a newly developed software tool for accessing Matlab functionality directly from the Web. It enhances functionality of standard Matlab's m-files and provides an option to use these files via the standard web page forms. Anyone can make his or her Matlab algorithms accessible from the Web. He or she only needs to create standard m-file respecting special code convention required by our software solution. This tool does not require any special software on the client side (except web browser). From perspective of a remote user the developed application appears as the standard web page. In the paper, we will look at architectural overview of our solution, point out some implementation details, describe special requirements for m-files used by the developed software tool, and provide example of usage.*

Keywords: Matlab, Matlab Web Server, Java, Java Servlet API, remote computation.

INTRODUCTION

In the past there existed a relatively easy way how to publish static and dynamic content from the Matlab environment to the Web. This functionality was provided by Matlab Web Server developed by MathWorks [1]. After initial setup, user was able to develop dynamic web applications using m-files in conjunction with some specialized Matlab structures and functions. These specialized structures and functions were responsible for reading data from requests sent by clients, and for writing response data back to clients.

Matlab Web Server was very popular for its simplicity, and it was widely used in large number of various scenarios, by various groups of scientists, researchers and engineers. Some examples of its use can be found in [2-6]. It was also very useful tool in education process as can be seen in [7-10].

Unfortunately, Matlab Web Server was discontinued by MathWorks in 2006, and it is no longer available in newer versions of Matlab [11]. Currently, there exist some other solutions which allow accessing Matlab functionality from the Web [12], but none of them provide as easy and fast development of dynamic web applications as Matlab Web Server did.

1. MATLAB2WEB

Our newly developed solution, Matlab2Web, is trying to mimic functionality of discontinued Matlab Web Server. It provides users with capability to develop dynamic web applications directly in Matlab using only m-files.

1.1 Architectural Overview

Architectural overview of Matlab2Web solution is depicted in Fig. 1. This section provides the detailed description of all components and their functionality within Matlab2Web.

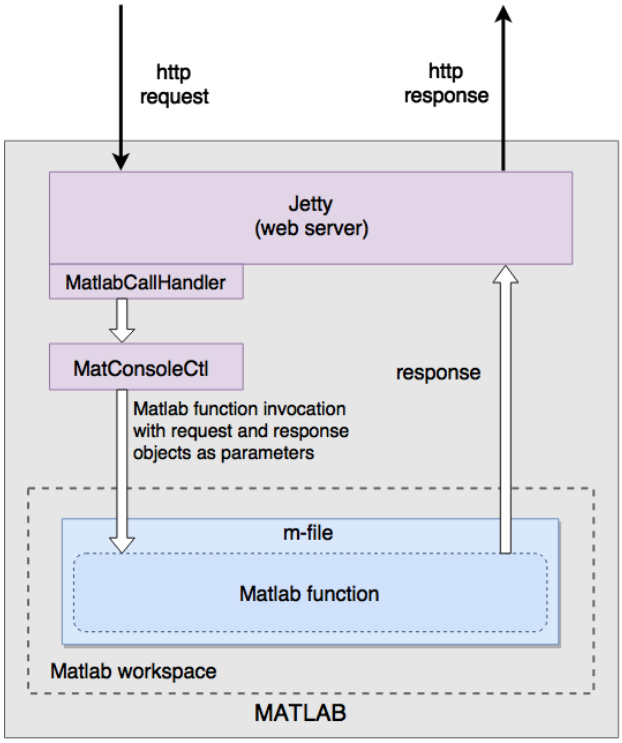

Fig. 1. Architectural overview of Matlab2Web
Source: own

Jetty [13] is lightweight web server and Java Servlet [14] container written in Java. It can be deployed as standalone server, or it can be embedded into other solutions. It is capable of serving static and dynamic web content. Its embedded variant is highly extensible and customizable. Matlab2Web incorporates embedded version of Jetty, in order to process initial http (HyperText Transfer Protocol) requests from clients, and to generate final http responses to clients. Jetty encapsulates raw http requests and responses into instances of HttpServletRequest [15] and HttpServletResponse [16] respectively. These instances are then used in the underlying parts of Matlab2Web solution, and are also passed into user defined function inside m-files.

MatlabCallHandler was developed in order to handle http requests, which are requesting Matlab function invocation. It takes advantage of one of Jettty's extension points, which allows to customize behaviour of http request handling. MatlabCallHandler scans each request and filters it based on request's url (Unified Resource Locator). If certain condition is satisfied, Matlab function is invoked. If the condition is not satisfied, http request is passed to the default handler provided by Jetty, which handles static web resources such as html files, css files, javascript files, or images.

MatConsoleCtl [17] serves as communication bridge between Java and Matlab. It allows executing Matlab commands, calling Matlab functions and getting and setting Matlab

variables from Java. In context of Matlab2Web it is used for invocation of Matlab function inside Matlab workspace from MatlabCallHandler.

1.2 Development of dynamic web applications using m-files

Matlab2Web uses m-files in order to generate dynamic web content. These m-files must adhere to some rules to be recognized and accepted by Matlab2Web. Each m-file must contain one function. The name of the function must match the name of the m-file (without the .m suffix). The function must accept two input parameters, and declare no output parameters. Two input parameters represent request and response objects which are instances of HttpServletRequest [15] interface and HttpServletResponse [16] interface. They are standardized Java interfaces representing abstraction of http request and http response. Basic aim of these two objects is to access data sent to the Matlab function from a client and write generated data back to a client. However, request and response objects can also provide more advanced functionality, e.g. finding out which http method (GET, POST, PUT, DELETE, …) was used with request, reading request headers and setting response headers, or setting custom response content type.

Generally, structure of m-file used in Matlab2Web application can be divided into three sub-categories:

1) reading and parsing values from request object into Matlab variables,
2) running Matlab computation using variables obtained in previous step,
3) generating appropriate output and sending it back to the client using response object.

Simple example of such m-file can be seen in Fig. 2.

```
function add(request, response)
       % reading and parsing values
       num1 = request.getParameter('num1');
       num2 = request.getParameter('num2');
       matlabNum1 = str2double(char(num1));
       matlabNum2 = str2double(char(num2));

       % running computation
       result = matlabNum1+matlabNum2;

       % generate output for the client
       writer = java.io.PrintWriter(response.getWriter(), true);
       writer.println('<!DOCTYPE html><html>');
       writer.println('<head><title>example</title></head>');
       writer.println('<body>');
       writer.println(['<h1>result is: ', num2str(result),'</h1>']);
       writer.println('</body></html>');
end
```

Fig. 2. Example of m-file structure used in Matlab2Web application
Source: own

2. SAMPLE WEB APPLICATION

A simple web application was created to test and demonstrate functionality of the developed solution. The web application computes and plots output of arbitrary dynamic closed loop system with PID controller. The dynamic system is represented by a transfer function, and

PID controller is represented by its P, I, and D coefficients. Output of the system, as response to the input step function, is plotted into graph.
Since users can specify the transfer function of an arbitrary system and define arbitrary coefficients of PID controller, this application can be used as simple verification tool for PID controller designs. The example of such usage can be seen in Fig. 3. It contains screenshot from the application with filled out values for speed control of DC motor described by transfer function

$$G_{(s)} = \frac{0.01}{0.005s^2 + 0.06s + 0.1001}$$

and controlled by PID controller with transfer function

$$C_{(s)} = 100 + \frac{200}{s} + 10s$$

Detailed analysis of DC motor system can be found in [18], and the design of PID controller is described in [19].

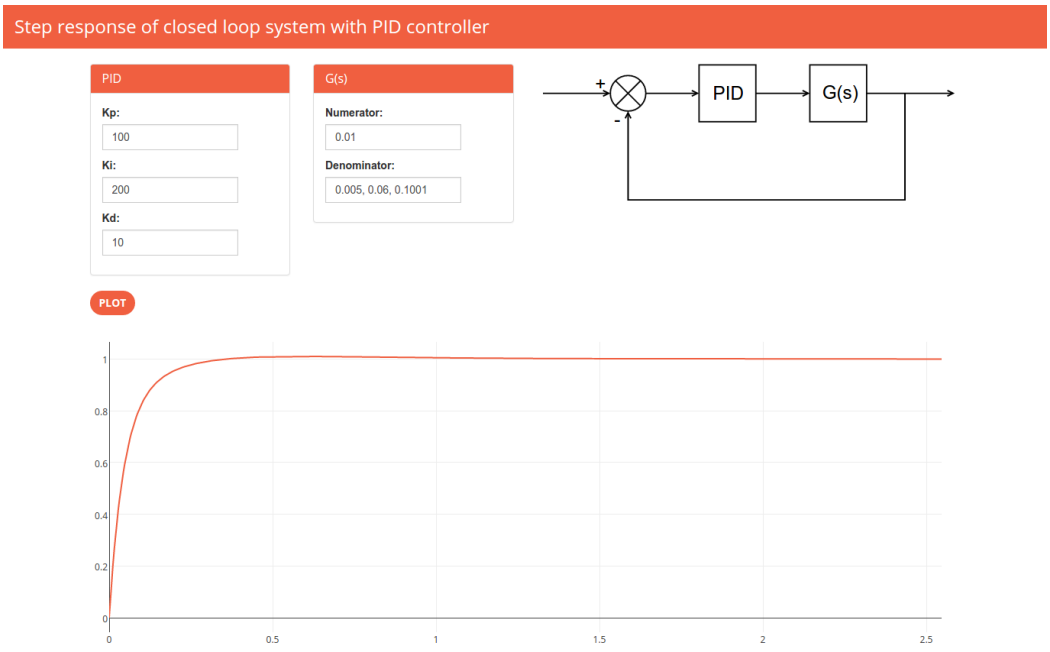

Fig. 3. Screenshot of the sample web application
Source: own

CONCLUSION

This paper described newly developed solution, Matlab2Web, which provide users with capability to develop dynamic web applications using only Matlab and m-files. There are also explained additional requirements for m-files which must be satisfied before they can be used with Matlab2Web. In the last part, the paper shows example of dynamic web application developed using Matlab2Web solution.

Development and testing of the sample web application was done in Matlab 2015a. It is necessary to mention, that users who wish to publish Matlab's functionality to the Web using Matlab2Web solution are required to have appropriate license for their Matlab product.

Matlab2Web can be used in wide range of application areas, such as remote and distributed computation, remote experiments, or remote monitoring. One distinguished area is education, where Matlab2Web can be used as a support tool or an alternative for standard on-site laboratory classes.

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Acknowledgement
The work presented in this paper has been supported by the Cultural and Educational Grant Agency, grant KEGA 025STU-4/2017 and by the Slovak Research and Development Agency, grant APVV-0343-12.

TOVEK TOOLS USED IN DISTANCE LEARNING

Kamil Halouzka[1]**and Ladislav Buřita**[1,2]
[1]University of Defence, Kounicova 65, 662 10 Brno, Czech Republic,
kamil.halouzka@unob.cz, ladislav.burita@unob.cz
[2]Tomas Bata University, Zlín, Mostní 5139, 760 01 Zlín, Czech Republic,
burita@fame.utb.cz

Abstract: *The paper describe the possibility of using the software Tovek Tools (TT) in distance learning (DL). The paper analyses the TT modules that are used for information retrieval, information analysis and generating different kinds of summaries and reports. The TT is suitable for working with large amounts of data from various informational sources. The article presents possibilities of TT for education of classified information protection in distance learning.*

Keywords: distance learning, text mining, Tovek Tools, security, protection of classified information.

INTRODUCTION

The article presents the possibility of using the software (SW) Tovek Tools (TT) in distance learning (DL), as a tool for text mining (TxM), by studying of the chosen subject (theme). Text mining is the analysis of data contained in natural language text. The application of text mining techniques to solve business problems is called text analytics [9]. Generally is TxM a part of Data Mining (DM), for detecting of unobvious facts from large databases.

First, it was found in what circumstances is possible to find in the scientific literature connections between DL, DM and TxM. Follows a brief description of modules TT: Index Manager provides preparation of text sources, in Tovek Agent and Query Editor a search is conducted; Info Rating allows contextual analysis and Harvester content analysis. The core of the paper is in practical experiment of using the TT for the DL.

1. LITERATURE RECHERCHE ON THE TOPIC OF THE ARTICLE

Combination TXM and DL is not in scientific literature so often. The DM and TXM is mostly use in detection of information for support of the main functions of the organization or to gain competitive advantage. In the paper [8] is described the use of a DM tool at Ceska Sporitelna, for segmentation of its clients in base of more than 5.2 million customers. The used tool is SAS Enterprise Miner that combines of both statistical and non-statistical methods.

The greatest difference between DL and traditional face-to-face learning in the classroom is in its independence from time and space. It bars the real-time communication of individual learner with teachers and other learners in time. In order to get better effectiveness, it is very important for education providers to evaluate the teaching-learning effects, to find the deficiency of distance education system and to remedy it by some ways. Traditionally, it is difficult to find suitable method to complete the task. Thanks to information technology, DM

can be an appropriate technique to evaluate the effectiveness of distance education. It is presenting uses the DM and TxM techniques in the evaluation of teaching-learning effect [5].

In order to improve the efficiency of DL evaluation, is proposed the word segmentation method to process electronic text documents recorded students' information in DL, from which students' information can be extracted knowledgably by TxM technology and thus can be compared with their study goal using association analysis. Through record mining method, mode analysis and evaluation on the students' learning behaviours can be done. Moreover, on the basis of evaluation data, study feedbacks can be provided and the evaluation results of students' learning can be obtained under the guidance of the index system and evaluation standard of evaluation rubric [4].

Ontology is an effective formal representation of knowledge. In open and DL, ontologies are used as knowledge bases for e-learning supplements, educational recommenders, and question answering systems that support students with much needed resources. In such systems, ontology construction is one of the most important phases. Since there are abundant documents on the internet, useful learning materials can be acquired openly with the use of ontology. However, due to the lack of system support for ontology construction, is presented a support system for ontology construction using pattern-based mechanisms to discover concepts and conceptual relations from text documents. In this system is used the combination of statistics-based, DM, and natural language processing methods [7].

Online forums represent one of the most popular repositories of user generated information over the internet. Searching information of interest in an online forum may be substantially improved by a proper organization of the forum content. With this aim is proposed an approach that enhances an existing forum by introducing a navigation structure that enables searching and navigating the forum content by topics of discussion. Topics and hierarchical relations between them are extracted from the forum content by applying information retrieval techniques, specifically Topic Models and Formal Concept Analysis [3].

On a daily basis, a large amount of data is gathered through the participation of students in e-learning environments. This wealth of data is an invaluable asset to researchers as they can utilize it in order to generate conclusions and identify hidden patterns and trends by using big data analytics techniques. The purpose is a threefold analysis of the data that are related to the participation of students in the online forums of their University. The content of the messages posted in these fora can be efficiently analysed by TxM techniques [6].

Asynchronous discussion forums are one of the artefacts of the internet age. They occur in a wide variety of applications from DL to technical support. Two examples such forums are the following: customer pre-sales; and internal forums where technical staff attempt to provide assistance to sales teams. In the paper is a study of a support forum for pre-sales in a large Fortune-10 global enterprise. The data being generated on such forums is fast evolving, requires quick and intelligent human responses, and is of high value to the enterprise since it directly affects sales. The TxM methods are used to detect trends in forums using clustering and information-theoretic techniques [2].

The paper summarizes the evolution of research topics in international engineering educational journal and offers a recollection of research topics for future scientific investigations. The selected journal for text data investigation is the European Journal of Engineering Education spanning from 1978-2012. In order to confirm extracted topics, but

also to account for complementary topics, two TxM techniques were applied in five years segments by extracting 6 and 10 topics from the corpus of documents associated with each segment. These topics were then analysed to determine how the overall engineering education evolved over a period spanning approximately three decades. The results indicate that engineering education has evolved from teaching basic engineering and design skills, computers, systems and processes; to creative teaching strategies and didactic curriculums, integrated design technologies and developing technologies [1].

2. FUNCTIONS OF THE TOVEK TOOLS

The TT is a desktop application designed for TxM in information searching, various types of analysis and the creating of summaries and reports. This is suitable for working with large amounts of text data from various informational sources. The TT is mostly used in news reporting, research and development in the investigation and detection of crime, or mapping the competitive environment. In the commercial sector are used mainly in media agencies, providers of information or in the financial sector, banks and insurance companies. In public administration they are mainly used in government and public institutions, the ministries, police forces and the security and intelligence community [10].

Index Manager performs manual or automatic indexing various types of documents, database records (using ODBC-Open DataBase Connectivity) and e-mail messages. It uses fast and reliable filters that support all common data formats (MS Office, Open Office, PDF, etc The last version of TT is able to index sources in many languages: Czech, English, Arabic, Chinese, Danish, Finnish, French, Italian, Japanese, Korean, Hungarian, Norwegian, German, Polish, Portuguese, Rumanian, Russian, Greek, Slovenian, Slovak, Spanish, Swedish, Turkish, and Vietnamese.

Tovek Agent serves as the interface to search in indexed documents from the information sources through queries and the search results are displayed. Thanks to the features used technology offers advanced search methods, including evaluation of the relevance of retrieved documents and their alignment, automatic clustering of documents by the common content search in different languages simultaneously and automatically create annotation of documents.

Query Editor is intended for expert users, which helps to create and debug structured queries in so called “TOPIK” used for an accurate search in large volumes of data. TOPIK allows specifying in the form of a visual tree exactly all words, phrases and other search features, which can be used to describe the search object.

InfoRating performs contextual analysis of selected documents, which finds and shows relations between the contents of found documents and defined themes. The result is shown in the form of matrix or in graph.

Harvester allows performing content analysis, especially for automated determination of the topic of the document; to select the documents with similar themes, and to identify new topics in the sets of documents (trends). Topics are identified, based on statistical analysis of occurrence of close words pairs and triples.

Others tools for information analysis

There are many software (SW) products like Text Analytics SW from OdinText Company, DataMatch SW from Data Ladder Company and Clustify text analytics SW that are focused on information retrieval and IA that include indexing if information sources (documents, e-mails, databases) and searching in the indexed sources. Part of that SW product implements subsequent work with the sources such as establishing of patterns, determining of the relevance and implementation of context and content analysis. The advantage of TT is that introduced Tovek tools functions are more complex than mentioned SW analytics tools functions.

3. TOVEK TOOLS IN DISTANCE LEARNING – EXAMPLE

All mentioned functions of Tovek Tools is possible very effectively use in distance learning. The experiences are from the course Creation of Communication and Information Systems for ICT students of study program in Master's degree at the CIS Department of the Faculty of Military Technology, University of Defence in Brno, Czech Republic. The initial lecture focuses on the explanation term's data, information, knowledge, metadata, databases and data structures of database systems. Also, the historical horizon of data search is mentioned: from library index systems through Boolean to the concept search. The further teaching block deals with phases of text processing and with SW Tovek Tools (TT) module for searching and analysing information. The teaching takes the form of training. Working with TT modules is at first tried on a small document base which includes about two hundred documents.

As an example will be shown students examination with topic concerning classified information. The legal regulation of ensuring the protection of classified information in the Czech Republic solve Act No. 412/2005 Coll., on protection of classified information and on security clearance, as amended. Students who want to closely become acquainted with that Act and Executive order of the National Security Authority (NSA) can download Czech version of documents from NSA web page. There are available mentioned Act concerning protection of classified information, 54 Executive orders and annexes to Executive orders.

On closer acquaintance with downloaded documents in the form of file format *.doc, and *.pdf students have to indexing it in Index Manager. The result of the indexing process is a new or updated full text collection that can be continuously updated.

Next step is to learn some important characteristic of Act and Executive orders. For that task students use Tovek Agent that search in newly indexed documents. One of the student's task could be search for types of classified information, see Fig. 1, left part. The result is in the form of a list of retrieved documents ordered according to relevance to the query, see Fig. 1, right part. Document text with highlighted searched words shows six type of classified information (Personnel security, Industrial security, Administrative security, Physical security, Security of information and communication systems, and Cryptography protection).

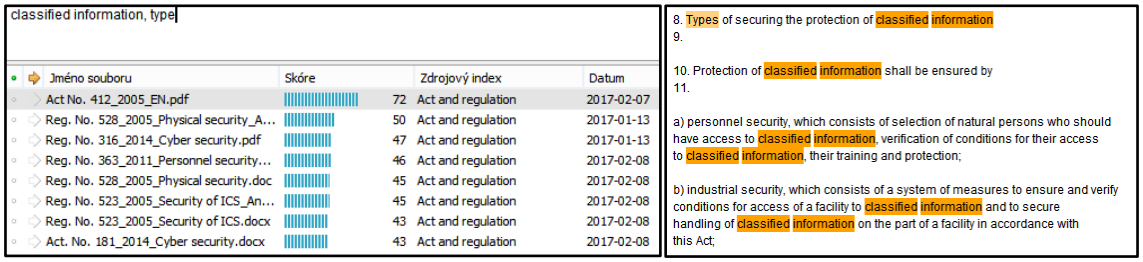

Fig. 1. The question with the result; document in TT viewer
Source: own

Next logical step is context analysis of the selected documents that is based on contextual queries, see Fig. 2. The goal of context analysis is to find in a set of documents only those that describe the specific contexts. Students' interest is still focused on type of classified information.

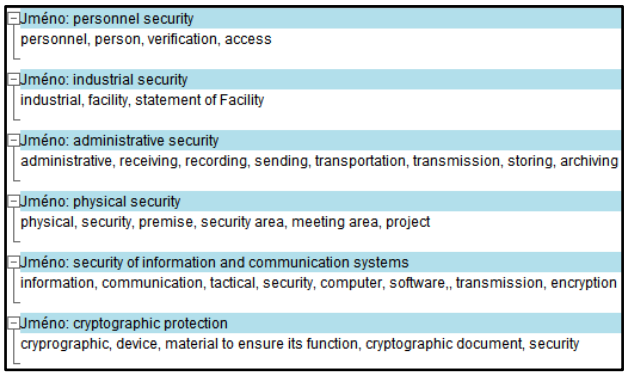

Fig. 2. Context editor used in InfoRating
Source: own

Students can easily identify relationships between retrieved document contents (Act and Executive orders) and defined themes (type of classified information) in the form of a cross matrix or a chart, see Fig. 3. In the Cross matrix the first column shows the number of documents corresponding to each query and in other columns are associations between document content.

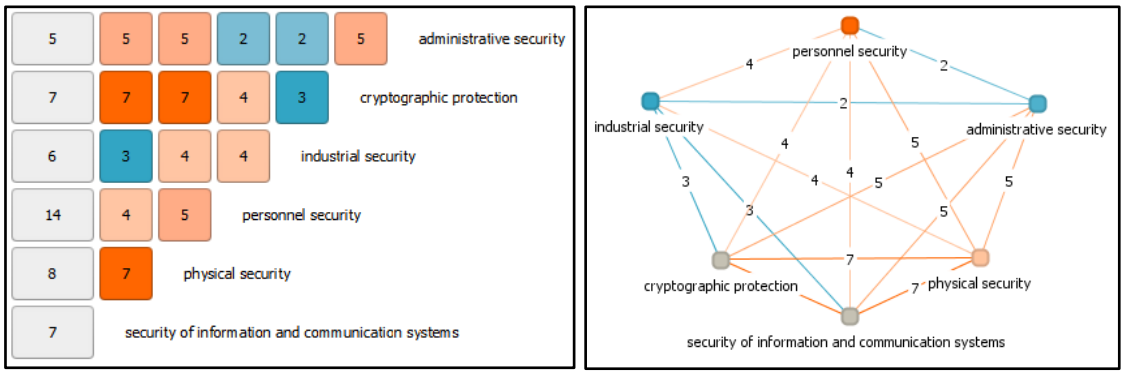

Fig. 3. Result of InfoRating context analysis
Source: own

The content analysis of selected documents can students perform in Harvester, which analyses the content of Act, Executive orders and annexes, and arranges words and their relationships see Fig. 4. Harvester allows students viewing of analysis results by typing relevant word;

graphical browsing of relations between relevant words; examining clusters of relevant words; tracking the surrounding of relevant words; and finding trends.

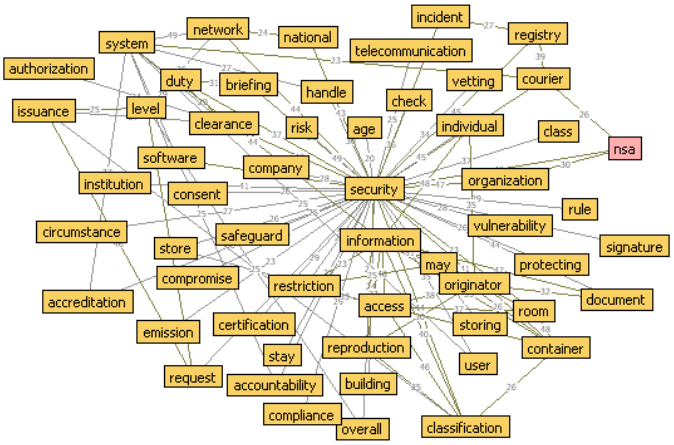

Fig. 4. Harvester content analysis
Source: own

CONCLUSION

The paper summarizes the authors' experiences with TT in distance learning education. TT is an excellent application that help university student fast clarifying and understanding of a new topic. The paper is focused on protection of classified information and analyse only unclassified publicly available information sources from the Czech NSA. Students searched for types of classified information; in the form of a cross matrix or a chart examined with context analysis; and used Harvester for content analysis of selected documents. For distance learning is TT very suitable because it improve students' skills to work individually and innovatively.

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Acknowledgement
The work presented in this paper has been supported by the institutional research in project DZRO K-209 University of Defence, Faculty of Military Technologies, CIS Department, realized in years 2016-2020.

NATO MODELLING AND SIMULATION EDUCATION AND TRAINING CURRICULUM – DO WE NEED A NEW NATO MILITARY DISCIPLINE?

Jan Hodický and Josef Procházka
Centre for the Security and Military Strategic Studies,
Kounicova 65, 662 10 Brno, Czech Republic,
jan.hodicky@unob.cz, josef.prochazka@unob.cz

Abstract: *NATO Modelling and Simulation Group Exploratory Team (MSG ET-40) defines the meaning of the NATO M&S Professional and has identified the General and NATO M&S minimum required competences. The outlined process of collection and sharing the M&S educational opportunities within Nations and NATO together with the NATO and National M&S E&T Catalogue allows to increase the awareness on M&S and to demonstrate its potential to become a military discipline. Established NATO M&S E&T Roadmap defines the track and General and NATO M&S competencies needed for being certified as the NATO M&S Professional. The review of currently available NATO and National M&S Education opportunities and its confrontation with required NATO M&S competencies revealed the following missing set of E&T key domains: M&S in Support of NATO Individual Training, M&S in Support of NATO Operations, M&S based Acquisition (Procurement), Develop and translate military requirements for M&S capability development, NATO Verification and Validation and Accreditation (VV&A), NATO Computer Assisted Wargaming. The key MSG ET - 40 recommendation is to establish Modelling and Simulation as a new NATO military discipline. First author of the article was co-leading this activity.*

Keywords: modelling and simulation, education and training, curriculum, M&S Education Roadmap, discipline.

INTRODUCTION

Through the establishment of the NATO Modelling and Simulation Coordination Office, NATO Modelling and Simulation Group (NMSG) and other bodies, NATO has developed an M&S Master Plan [1], technical and procedural standards for M&S systems and architectures and supported a wide range of M&S application areas; but NATO has not yet developed a clearly defined concept for M&S professionals. There is recognized requirement for a defined certification process which incorporates education, training, experience and NMSG membership agreed upon procedures which will help to increase awareness, promote interoperability standardization and further develop the professional M&S Corps within NATO [2],[3].

According to its Operational and Functional Memorandum of Understanding with ACT, the NATO Modelling and Simulation Centre of Excellence (M&S CoE) is chartered to provide education and training opportunities for NATO and Partners in the Modelling and Simulation domain. The M&S CoE is requesting support from NMSG and Nations to determine the best course offerings for a more comprehensive approach towards training and education of an M&S professional within NATO.

1. OBJECTIVES, LIMITATION AND CONSTRAINTS

NMSG has decided to create the Exploratory Team (ET - 40) with the overall aim to develop a comprehensive education and training program to be implemented over a multi-year period in order to increase the level of professionalism for M&S personnel across NATO and Nations. The lead over the ET – 40 was designated to the M&S CoE, namely the first author was in charge.

The main objective of the study was to:

- Define what it means to be an M&S Professional in NATO.
- Identify General and NATO M&S specific competencies.
- Outline a process to collect, inform and access M&S educational opportunities within NATO and Nations.
- Identify initial NATO and National M&S Educational Opportunities.
- Identify initial priority gaps between current educational opportunities and desired NATO competencies.
- Recommend Certification process, outlining a framework for competency based certification.

The scope of the ET-40 was limited to the previously defined objectives. The main purpose as stated above was to gain an understanding of the educational requirements, so that the appropriate courses shall be developed for NATO M&S professionals. The following activities have been identified as necessary to meet the ultimate goal; however, are outside the scope of this ET.

It is recommended they be completed through an MSG or other body:

- Develop courses' development timelines and priorities ensuring most critical courses are developed first based on identified NATO M&S competencies.
- Define educational courses and layout general syllabi. (Course content will be a follow on effort by M&S CoE and partners.)
- Explore the best methodologies for delivering content: online, classroom, lecture series, self-study, hybrid approaches, etc. Incorporate already existing courses) into the M&S Education & Training (M&S E&T) Roadmap.

2. NATO M&S PROFESSIONAL

The ET-40 has approved the following definition of the NATO M&S Professional.

A NATO M&S Professional is someone who:

- Possesses expert knowledge, skills and competence in the field and understands how to apply them in the NATO M&S Application Areas as outlined by the NATO M&S Master Plan.
- Maintains current knowledge of and enforces NATO M&S standards, while supporting development of new standards where none exist and improving established standards.
- Keeps an open mind, understands the M&S needs, and works to develop and introduce innovations in the technologies and processes used by NATO M&S Practitioners.

- Is dedicated to serving the Alliance in the M&S field through Allied or National efforts which support all phases of life-cycle of security related capabilities.
- Continues the pursuit of professional development in the field of M&S to benefit national and NATO interests' development.
- Understands and abides by the code of Professional Ethics for Modelling & Simulation.

3. M&S COMPETENCIES

This chapter describes the M&S competencies that define the requirements to become M&S professional in the general and in the NATO context as well.

3.1 General M&S competencies

General M&S competencies describe the set of minimum required skills and knowledge to become the M&S Professional. This classification doesn't reflect the level of NATO M&S certification and the tracks and it's coherent with the main understanding of the M&S Body of Knowledge [4], [5].

It is required to have knowledge, skills, and experience in:

1. M&S terminology. He or she understands common M&S terms and definitions. Example (LVC, Model, Simulation, Monte-Carlo, Deterministic)
2. Statistics and probability. He or she understands statistic and probability principles. Example (Knowledge needed to understand Stochastic Simulation and Experimental design)
3. M&S history. He or she understands the historical perspectives and evolution of M&S.
4. Applications of M&S. He or she understands how M&S can be leveraged to support various activities and requirements. Example (Training, Analysis, Problem-solving, Education, Decision Support, War gaming)
5. Domains of M&S. He or she understands that M&S can be applied in multiple domains.
   Example (Military, healthcare, engineering, business, civil protection)
6. M&S life-cycle. He or she understands the phases of the M&S life-cycle.
   Example (Develop, build, implement, dispose)
7. M&S related practices and methodologies (Project Management). He or she understands processes within the M&S life-cycle and familiarity with their implementation.
   Example (Requirements Analysis, Conceptual Modelling, Verification Validation and Accreditation (VV&A))
8. M&S related disciplines. He or she understands that M&S relies on inter-disciplinary approaches.
   Example (Computer Science, Software Engineering, Systems Engineering, Information Technology)
9. M&S Management. He or she understands how to implement and utilize M&S Tools and services.
   Example (Lead a team that utilizes M&S)
10. M&S in support of systems engineering process. He or she understands how to integrate M&S into systems engineering processes.

Example (Computer Added Design, cost-estimation, performance modelling & analysis)

11. M&S standards. He or she understands the extent and importance of standards and how they are applied.
    Example (High Level Architecture, Distributed Interactive Simulation)
12. Distributed Simulation principles. He or she understands the concept and key principles of distributed simulations.
    Example (DSEEP, HLA, DIS, TENA)
13. M&S ethics. He or she understands the professional responsibilities and liabilities in the development and employment of M&S.
    Example (Society for Modelling and simulation International Code of Ethics)
14. M&S organizations and entities. He or she understands the principal M&S organizations and entities across the world, and their role in M&S technology, education, or application.
    Example (SISO, NTSA, M&SCOE, MSCO, ITEC, I/ITSEC, SIMTEC)
15. Future Watch and Innovation. He or she is familiar with concept of innovation: applying new ideas to add value.
    Example (Serious Games, VBS 3 Case Study)

3.2 NATO M&S competencies

NATO M&S competencies describe the set of minimum required skills and knowledge to become the NATO M&S Professional. This classification doesn't reflect the level of NATO M&S certification and the tracks and doesn't require covering all previously defined General M&S Competencies.

It is required to have knowledge, skills, experience in:

1. NATO M&S terminology. He or she understands NATO specific terms and definitions.
   Example (Defined in MSG 120 Glossary of Terms)
2. NATO M&S military application areas based on the NATO M&S Master Plan. He or she understands how NATO defines and applies M&S to support military activities.
   Example (5 Application Areas: mission rehearsal, support to operations, etc.)
3. NATO M&S and M&S related standards. He or she understands key standards regarding M&S and familiarity with standardization processes used by the NATO M&S Community of interest.
   Example (STANAGS, Best Practices, Allied Modelling and Simulation Profiles)
4. M&S systems and M&S related SW tools used by NATO. He or she is familiar with the common M&S systems and M&S related SW tools in NATO used for all M&S application areas specified in the NATO M&S Master Plan.
   Example (Joint Conflict and Tactical Simulation, Joint Theatre Level Simulation)
5. NATO C4I Systems & Interoperability. He or she understands how and why M&S is used to stimulate and exchange data with command and control systems. He or she understands the fundamentals of technical interoperability. (C2SIM; SIM-C2; C2-C2) He or she is familiar with the various C2 systems used by the NATO Command & Force Structure.
   Example (Air Command and Control System, Federated Mission Network, Military Scenario Definition Language, Coalition Battlefield Management Language)
6. NATO and National Organizations in the NATO M&S COI. He or she understands NATO organizations that lead and support M&S activities and their roles in policy,

capability development and training. He or she is familiar with National and non-NATO entities that support allied M&S efforts.
Example (NMSG, Joint Warfare Centre, Joint Force Training Centre, National Simulation Centres)

7. NATO Collective Training. He or she understands how M&S supports all levels of collective training within NATO. He or she is familiar with NATO Exercise Planning Process.
   Example (Allied Modelling and Simulation Profile-05, Bi-SC 75-2, 3, 7)
8. NATO Individual Training. He or she understands how M&S supports individual education and training within NATO.
   Example (Sim-based education, Advance Distance Learning, virtual simulations, immersive environments)
9. M&S in Support of Operations (NATO). He or she understands how M&S can support military operations.
   Example (Rapid Terrain Modelling, Real-Time-Decision Support Tools, Situational Awareness Tools, After Action Review, Lessons Learned, Threat Analysis)
10. M&S based Acquisition (Procurement). He or she is familiar with how M&S supports all phases of an acquisition life-cycle.
11. Develops and translates military requirements for M&S capability development. He or she understands how operational requirements are generated and translated to M&S requirements.
12. M&S in support of Concept Development & Experimentation. He or she understands how M&S can be used to explore, test and evaluate new military concepts and capabilities.
13. NATO VV&A. He or she is familiar with basic VV&A principles and understanding of the importance of VV&A to all M&S application areas within NATO.
    Example (General Methodology for VV&A)
14. NATO Computer Assisted Wargaming. He or she is familiar with basic application of M&S in the Wargaming for the NATO planning and experimentation purposes.
    Example (M&S supporting the analytical part of the planning and experimentation)

4. NATO M&S EDUCATION AND TRAINING ROADMAP

Following Table 1 matches the proposed certification tracks and M&S competencies and serves as a tool to identify the gaps in National and NATO M&S E&T opportunities. At the moment only two levels of certification were identified and it is draft version. The further investigation must be done in the explicit definition of the levels of certification and required levels of skills.

General and NATO M&S NATO M&S competencies and certification Levels					
Tracks	**Defined**	**Includes, but not limited to**	**General M&S competencies**	**NATO Basic Level**	**NATO Expert Level (Basic +)**
Manager	responsible for managing/ leading M&S activities or programs	Project Manager, E&T Supervisor, Simulation and Training Centre leadership, M&S Policy makers, Academic leaders	1, 3, 4,6, 9, 11, 13, 14, 15	1, 2, 3, 6	5, 7, 8, 9, 10, 11, 12, 13,14
Developer	responsible for research, development and engineering of M&S and related systems	Systems Engineers, M&S Engineers, Computer Scientists, Mathematicians, Project Officers, Network Architects, CD&E Staff	1,2,10, 11, 12, 13, 15,	3, 5,	4, 7, 8
Operator/ Trainer	responsible for conducting daily activities with M&S systems	CAX Specialists, educators and instructors, database managers, network managers, operations/ research analysts	1, 10, 12, 13	4,5, 6	7,8,9,12,13,14

Table 1. NATO M&S Education and Training RoadMap
Source: MSG ET-40 Final Report

CONCLUSION

The papers summarize the main findings of the ET 40 work with the special focus on the general and NATO M&S competencies related to the M&S Body of Knowledge. The group identified the following list of courses as missing after the gap analysis of the current available courses in NATO and Nations and required NATO M&S competencies.

- NATO Individual Training. Understand how M&S supports individual education and training within NATO.
- M&S in Support of Operations (NATO). Understanding how M&S can support military operations.
- M&S based Acquisition (Procurement). Familiarity with how M&S supports all phases of an acquisition life-cycle.
- Develops and translates military requirements for M&S capability development. Understand how operational requirements are generated and translated to M&S requirements.
- NATO VV&A. Familiarity with basic VV&A principles and understanding of the importance of VV&A to all M&S application areas within NATO.

- NATO Computer Assisted Wargaming. Familiarity with basic application of M&S in the Wargaming for the NATO planning and experimentation purposes.

The first author of the article was co- leading this NATO effort and. Follow up activities will be focused on design and implementation of the NATO M&S Professional Certification Process and detailed design of identified missing courses' curriculum. Based on the ET-40 findings and recommendation, the M&S as a new NATO discipline should be implemented as soon as possible to better prepare our forces for the future security environment through coherent M&S Education and Training program.

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Acknowledgement
The work presented in this paper has been supported by the NATO Modelling and Simulation Group Exploratory Team (MSG – ET-40) during the one year of its existence in 2016.

E-LEARNING AS AN EFFECTIVE TOOL FOR THE FIRST MEETING OF PUBLIC WITH MODERN MATERIALS AND TECHNOLOGIES

Peter Juhász, Michal Micjan, Martin Weis, Peter Benko and Ľubica Stuchlíková
Slovak University of Technology in Bratislava, Faculty of Electrical Engineering
and Information Technology, Institute of Electronics and Photonics
Ilkovičova 3, 812 19 Bratislava, Slovakia, peter.juhasz@stuba.sk, michal.micjan@stuba.sk,
martin.weis@stuba.sk, peter_benko@stuba.sk, lubica.stuchlikova@stuba.sk

Abstract: *Semiconductor devices based on organic materials, such as organic field-effect transistors (OFETs), organic light-emitting diodes (OLEDs), and organic solar cells, have recently attracted research interest. The main motivations are: flexibility, transparency, biocompatibility and low-cost fabrication. This paper highlights author's motivation and practical experience gained through creation of open e-learning course named "Organic electronics" located on portal "eLearn central". The main aim of this open course is to familiarize the general public with this topic, with the research results and latest findings in Science and Technology.*

Keywords: e-learning course, organic materials, organic electronics, popularization of Science and Technology.

INTRODUCTION

The most electronics devices are based on the classical materials such as silicon (Si), gallium-arsenide (GaAs) and other well-known inorganic materials. Nowadays, electronic devices based on these materials already reached very high level and further improvement is difficult. Therefore, the research has been focused on development of new materials, which can provide alternative and/or replacement of the inorganic semiconductors. One of them, the organic semiconductors have been envisioned as materials that combine the electronic advantages of inorganic semiconducting materials with the optical, chemical, and mechanical benefits of organic compounds such as plastic materials [1].

Nobody thought that is the right way until the three scientists Alan J. Heeger, Alan G. McDiarmid, and Hideki Shirakawa in 1970's observed the electrical conductivity of conjugated molecules. Their invention was honoured by the Nobel prize in Chemistry in 2000 [2]. After this success the organic electronics has witnessed enormous world-wide effort both in basic scientific research as well as in industrial development. As a result, in the last decades' new electronic devices such as organic field-effect transistor (OFET) [3], organic light-emitting diodes (OLED) [4] and organic solar cells [5, 6] have arrived and attract the attention of scientific and industrial research. These electronic devices have excellent and unique features such as mechanical flexibility, low-cost fabrication, optical transparency, etc. which find the application in displays of mobile phones, flexible solar cells and so on. Recent research on organic devices has been concentrated on the applied research and focused on performance improvement. Future challenges are organic logic circuits, high efficiency organic photovoltaic cell, long-live flexible OLED displays and lightings.

Organic Electronics Lab at Institute of Electronics and Photonics at Slovak University of Technology in Bratislava has been founded in 2013. The main research topic of Organic

Electronics Lab is design and characterisation of organic devices. This research team is small in number but it's worldwide accepted since their results have been regularly published in number of CC journals and the team participates at various international research projects.

It is important to familiarize young generation, which will have to contribute to design of the next generation of organic devices with modern materials and technologies and their implementation, with the research results and latest findings in Science and Technology in area of organic electronics. We decided to use our experience in research [7 - 10], teaching and popularization [11, 12] of organic electronics technology, and e-learning [12 - 13] to create open e-learning course "Organic electronics" [14] to help youth as well as general public, clarify some questions from the field of organic electronics, to bring them answers and especially to attract their interest. We have no information about open e-learning course dealing with organic electronics that is suitable for our target group and with presentation of real research team. Aim of this paper is to highlight our motivation and practical experience gained through creation and to introduce this e-learning project.

1. E-LEARNING COURSE "ORGANIC ELECTRONICS"

E-learning course "Organic Electronics" (Fig. 1) had been developed in education portal "eLearn central" environment based on Moodle 2 platform [15]. This course is designated preliminary for scholars at high schools and bachelor students of the university; however, it is also for public. The access to this course in Slovak language will be unrestricted and free of charge. The main aim of this course is to familiarize the general public with the topic of Organic electronics from fundamentals to applications. The course contains not only basic information, but also the selected research results, latest findings in organic electronics and main research focus and results of Organic Electronics Lab at Institute of Electronics and Photonics at Slovak University of Technology in Bratislava.

1.1 The Course Content

The course "Organic Electronics" is divided into seven lessons – Motivation, Organic vs. inorganic semiconductors, Properties of organic semiconductors, Applications, Make your own OLEDs, Conclusion & Future and References. The first lesson "Motivation" introduces the aim of this course, the invention and brief history of organics electronics and describes motivation for research and usage of organic electronic. The second lesson "Organic vs. inorganic semiconductors" discusses selected differences between organic and inorganic semiconductors, which are needed to understand the organic semiconductors behaviour. Even though the organic semiconductors share some common properties with inorganic semiconductors, the underlying physics often differs and improper approximations lead to misunderstandings and misleading interpretations. Third lesson "Properties of organic semiconductors" provides basic information about fundamentals, electro-physical and chemical properties of organic semiconductors. Inner structure and fundamental principles of charge behaviour (carrier injection (Fig. 2) and transport) in organic semiconductors are interpreted by very friendly way. In this lesson there are also described materials and technologies used for fabrication of the organic electronic devices and discussed challenges in growth technology. The fourth lesson "Applications" is dedicated to description of operation principle, construction and application of real devices such as organic field-effect transistor, organic light-emitting diodes and organic solar cells. The emphasis is on applications that are a natural part of everyday life.

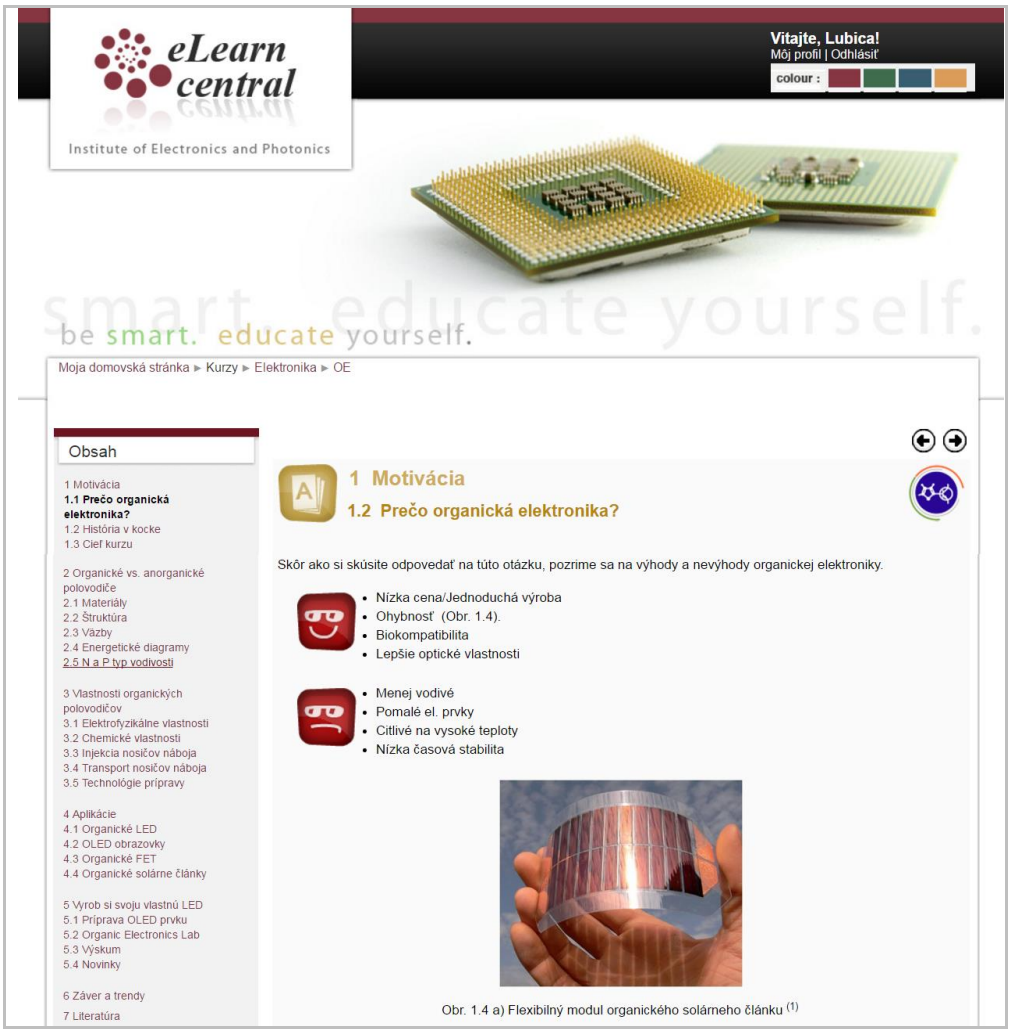

Fig. 1. User´s view of the entries in course "Organic electronics"
Source: own

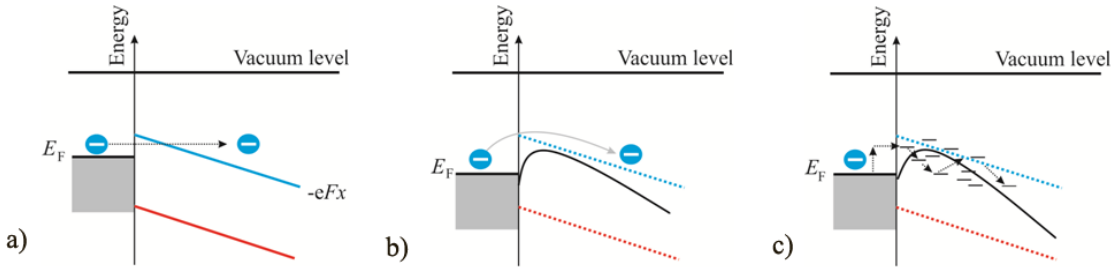

Fig. 2. Charge carrier injection a) Fowler-Nordheim tunneling, b) Richardson-Schottky Thermionic Injection and c) Injection through interfacial states
Source: own

The most interesting in the course would be the fifth lesson "Make your own OLEDs" dealing with the practical demonstration (Fig. 3) step-by-step of OLEDs fabrication in cleane room at Institute of Electronics and Photonics at Slovak University of Technology in Bratislava. This lesson introduces research focus and results (Fig. 4) of Organic Electronics Lab active at this Institute. Students have possibilities to be familiar with real research labs, scientific equipments, and unique research projects of real research group in Slovakia. The course is finished in sixth lesson "Conclusion & Future" where future applications are introduced with short conclusion followed by References.

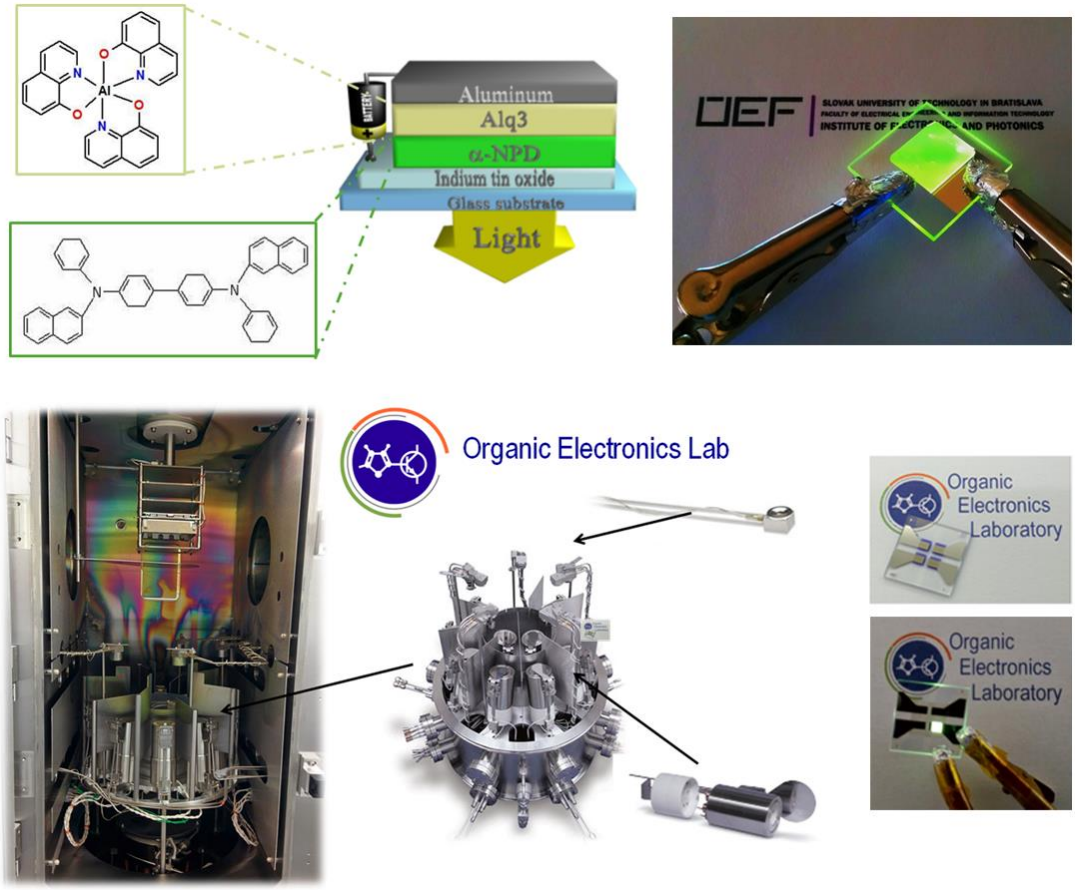

Fig. 3. Schematic diagram of the device ITO/α-NPD/Alq3/Al, examples of practical realization OLED made in Organic Electronics Lab at Institute of Electronics and Photonics and vacuum evaporation equipment for preparing of organic devices
Source: own

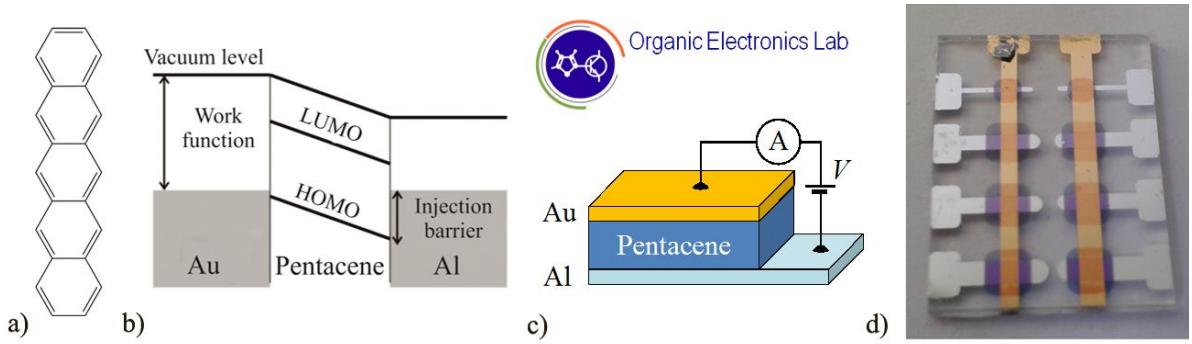

Fig. 4. a) Molecular structure of pentacene (organic semiconductor). Pentacene diode: b) the energy band diagram, c) device sketch, and d) photo of devices' array fabricated in Organic Electronics Lab
Source: own

1.2 The Course Format

The course "Organic Electronics" is mainly focused on youth, but it should have an impact on general public also. This target group is very special - the design of a course must be very attractive and also the language must be very friendly, easy-to-understand, and clear. Based on these facts the authors decided to create this e-learning course with many illustrative diagrams and pictures demonstrating the material properties rather than complex explanations.

Moodle Module Book has been exploited, which produces a feeling that the student is browsing a book. Each lesson consists of educational materials (short texts paragraphs, illustrative figures and photos, basic equations and clear diagrams) arranged in form of slides.

The main goal of this course is to provide bring-home message as basic information in fast and funny way that will attracts attention. Therefore each page of course is not larger than two regular screens. Single text was supplemented with motivation and feedback questions. Short sentence compositions were used within content creation and the sources have been cited accordingly (internet sources were inserted as hypertexts), for student to have a chance in case of interest to access directly the source. Educational texts are written in form of outline with bullet points supported by figures, photos, and/or graphs. This course has been created as a course suitable for self-education – therefore it uses "eLearn central" standard navigation elements. Students can easily browse through the course using next/previous buttons shown as arrows or navigation panel on left side of the screen. This navigation bar offers the whole content of the course up to second level of structuring. Icons are used for the identification of individual lessons which have been designed especially for educational portal "eLearn central" favour to enhancement of student orientation. Students have also the opportunity to write remarks and suggestions within News Forum.

CONCLUSION

Organic semiconductors are new materials used for electronic devices. Application of these novel materials gives new electronic devices which have unique properties such as flexibility, transparency, etc. Authors have been created rare e-learning course in Slovak language named "Organic electronics" located on portal "eLearn central". The main aim of this open course is to familiarize the general public with this topic, with the research results and latest findings in Science and Technology. The unique of this course is to get insight in the work, research, and motivation of real research laboratory (the only one in his field in Slovakia) – Organic Electronics Lab at Institute of Electronics and Photonics at Slovak University of Technology in Bratislava. The pilot version of the course is accessible for the public from May 2017. The authors are sure that this approach to design to e-learning course has potential to be an excellent tool not only for transfer of knowledge, research results and latest findings into the education process, but also to increase the interest of youth on this area of research and development.

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Acknowledgement
The work presented in this paper has been supported by the agency KEGA the Ministry of Education, Science, Research and Sport of the Slovak Republic for under Grant 020STU-4/2015 and by the Slovak Research and Development Agency (grants APVV-14-0739 and APVV-14-0740).

SYSTEM OF REMOTE APPLICATIONS USED AS LABORATORY FOR DC ELECTRICAL EXERCISES

Miroslav Kamenský, Eva Králiková and Jozefa Červeňová
Institute of Electrical Engineering, Faculty of Electrical Engineering and Information Technology STU in Bratislava
Ilkovičova 3, 812 19 Bratislava, Slovak Republic, miroslav.kamensky@stuba.sk

Abstract: *To increase efficiency of daily or distance learning a remote access to real workplaces could be employed. New system of remote applications was designed which is open for other designers who can add their own workplaces with their controlling software parts into this system. The concept and structure of the system is described in the paper. It is based on the pairs of superior and target modules. The superior modules distribute data to the remote user and are predefined by our team. The target modules control real workplace and communicate with superior module. Designer of a new target module only needs to implement the communication rules into their software. This concept brings several advantages for both designers and users.*

Keywords: LabVIEW, Data Socket, remote access, remote experiments, measurement.

INTRODUCTION

Experimentation is very important part of engineering study. Students of technical specializations need to obtain both theoretical knowledge and practical skills. For the latter real work in the laboratory is needed. However, limited capacity of laboratories often leads to reduction of number of students or working time. Online experiments bring partial solution of this problem. The number of this kind of solutions is constantly growing [1 - 3] and development was done using various technologies.

The paper demonstrates software system for remote access to experimental workplaces. Set of target modules were designed and added into the system. Presented applications allow learning of basics of electrical engineering and working with electrical measuring and laboratory equipment. The set of applications include module for measuring current-voltage characteristics of linear and non-linear electrical components and module for control of a DC motor. The former communicates with digital multimeter and DC power source and it exists also in simulation version. The latter similarly uses DC power source while incremental sensor and data acquisition card was added to get feedback of the motor speed. All the modules can be controlled remotely and present the measured data to the user over unified user interface. Thus the system friendly provides extended working time for students.

1. SOFTWARE TOOLS AND CONCEPT OF THE SYSTEM

Today several software tools are available suitable for development of applications with remote access, of simulations or visual aids. Taking into account the history of the application development at our institute we decided to use LabVIEW software environment for building the main parts of our modular software system [4]. The advantage of the LabVIEW is that it is easy to create working reliable programs also for novice programmers. It is suitable for the

development of interactive applications and it supports lot of hardware that is used within teaching process at our institute. Our students get familiar with this environment during practical exercises where real experiments are performed.

LabVIEW enables development of experiments on various levels. For creation of measurement courses LabVIEW offers many libraries oriented to measurement, communication, data processing etc. Besides those libraries it includes also Remote Panel and DataSocket components, which simplify the design of the system with remote access [4]. In general, by using Remote Panels any application built in LabVIEW can be published on the web. This technology turns the application into a remote laboratory with no additional programming or development time. For the remote user the only special prerequisite for using the remote access is installation of the Run-Time Engine version of LabVIEW (freeware from National Instruments). DataSocket Transfer Protocol (dstp) is based on the TCP/IP standard, being dedicated for sharing and publishing data [5].

Our modular system employs both technologies described above: Data Socket and Remote Panel (Fig. 1). It is based on pairs of modules formed from GO module and DO module. To access the remote workspace or target application called DO module the user communicates over a superior GO module, which is placed on a dedicated server computer. Its purpose is to accept commands from a remote user and forward them to a target application or to distribute results to the remote user. For every DO and GO module pair the GO module is identical except selected identifier (ID). DO module is unique, every carrying its own identifier (ID). On the central server computer several copies of GO modules are running and the number of those applications limits number of target applications accessed remotely at the same time. Pairing of GO and DO module is accomplished by selecting the ID of desired target application in superior GO module. The target module could be located on any computer within the local network which is not directly visible from outside and hence protected against software attacks.

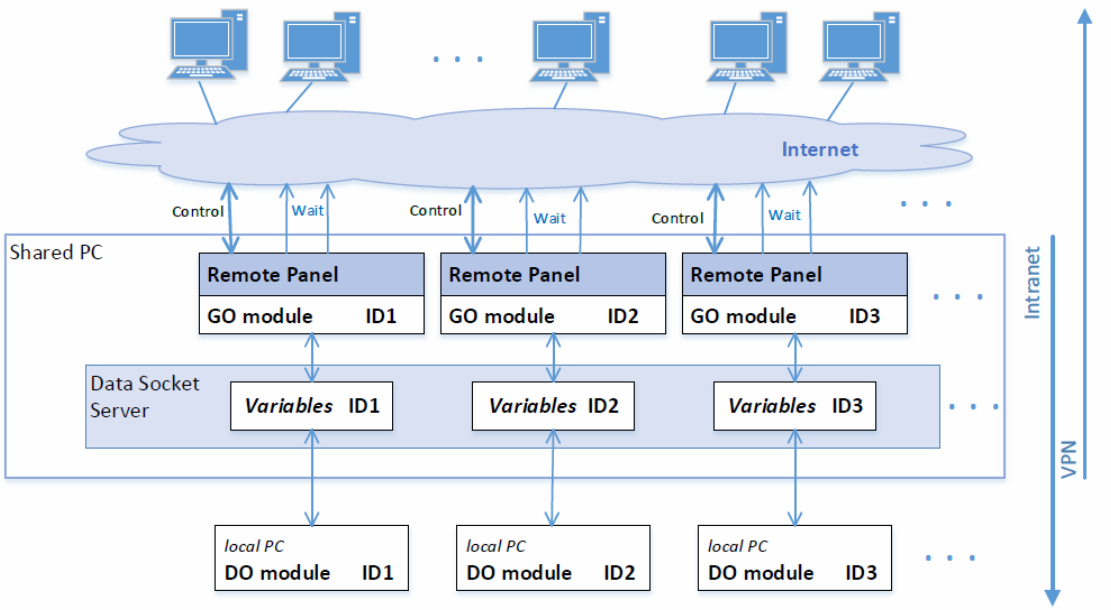

Fig. 1. Concept of the system
Source own

Properties of GO module determine concept of the target application design, which has to keep communication rules. The communication is always initiated by the GO module which sends one of following commands: Init Communication, Refresh, and Button Pressed. Response must be obtained from an authorized set of commands: Button Label, Plot Graph, Write Listing, Draw Picture, and Write only Message. The application operates in several modes. Those modes can be divided into two groups:

- Modes for managing the communication;
- Modes for processing data sent from the DO module and for the implementation of actions visible to the user.

For managing the communication four DataSocket variables were created. Two of them are used for sending commands: G_Com*ID* - for commands sent from the GO module, D_Com*ID* - commands sent from the DO module, i.e. received by GO module. Two another variables are used for data transmission: G_Var*ID* - data sent from GO module; D_Var*ID* - data sent from DO module being received by GO module. Here the label *ID* means identification number mentioned above, therefore every pair of GO and DO module communicates via different variables which protects against communication mismatch. All commands defined until today were listed in [6].

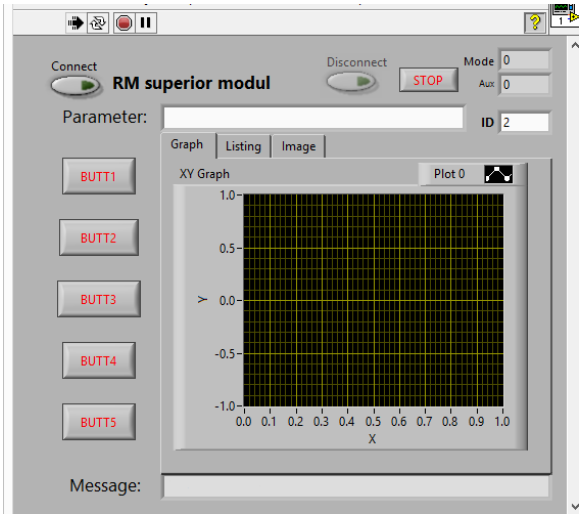

Fig. 2. Front Panel of GO module
Source own

The front panel of the GO module (Fig. 2) represents the user interface. The data flowing between modules correspond with visual components present on this front panel. For displaying data from measurement or from the workplace, there is tab control with three pages containing a graph, a listing (area for a multi-line text) and an image (for picture). In addition, there is an indicator under the tab control for displaying auxiliary text message. For controlling of the connected target application 5 push buttons are available on the left side of this front panel. Their functionality is determined by DO module which could rename them or make some of them invisible according to actual needs. When a button is pressed the button number is sent as the last byte of a three-byte command. Simultaneously with the command the auxiliary text parameter posted by the remote user is also sent. Finally, for starting and ending the connection there are buttons Connect / Disconnect placed on top of the front panel. The STOP button terminates the program entirely.

2. CURRENT-VOLTAGE CHARACTERISTIC MEASUREMENT

Our team created several target applications (DO modules) implementable into the presented software system. Here we describe application for measuring current-voltage characteristics of bipolar components. The user interface of developed software controlling the workplace for measuring current-voltage characteristics of electronic components is depicted in Fig. 3. The left figure shows the user interface of DO module which actually does not offer control buttons. In the Fig. 3 right the application is displayed in the way how the remote user sees

and controls the target module from Internet Explorer. Besides access over internet, there is also a possibility of DO module control directly using GO module located within the same network domain.

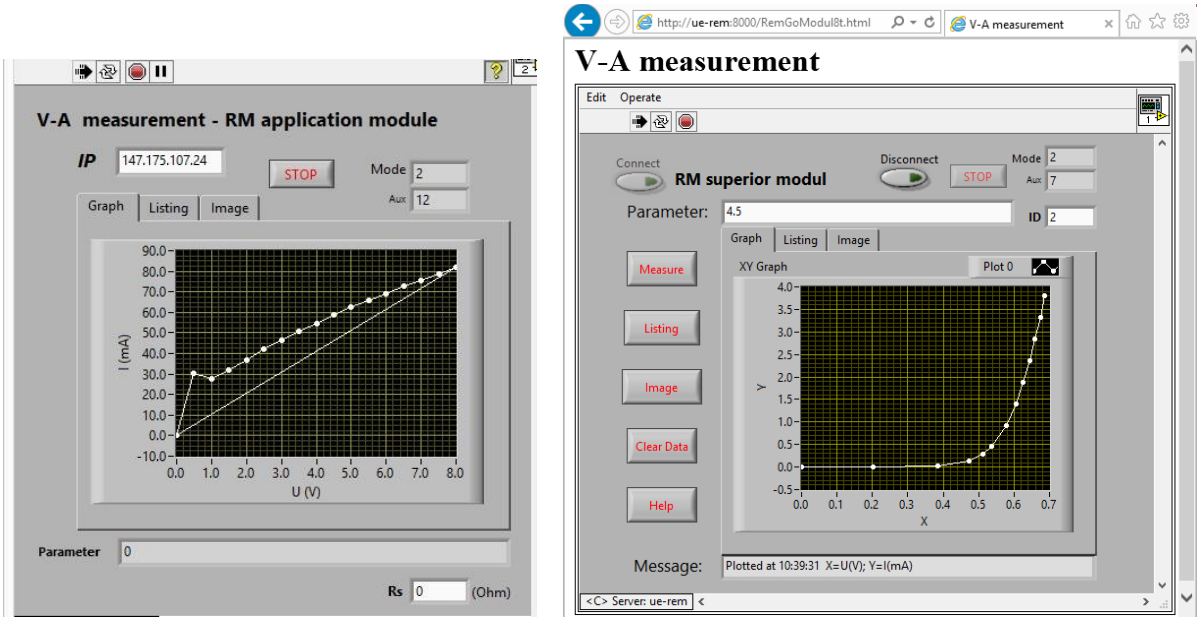

Fig. 3. Left – DO module; Right – GO module front panel accessed using Internet Explorer
Source own

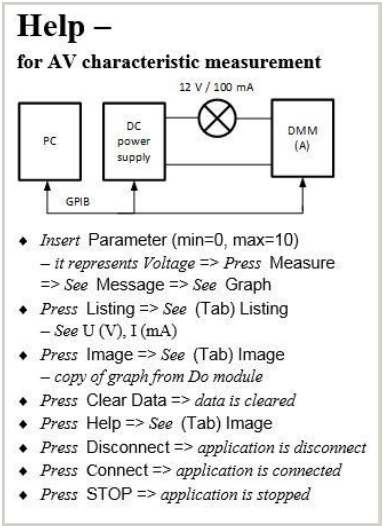

Fig. 4. Example of Help
Source own

After starting the GO module and pressing the ***Connect*** button the connection is initialized. The functionality of our application corresponds with labels assigned to the pushbuttons placed on the left side of the main tab control (Fig. 3 right). If the ***Measure*** button in GO module was pushed the measurement itself is accomplished. The *parameter* value received in DO module is forwarded to a DC source (Agilent 3640A) using GPIB bus. Then the current is measured by multimeter (Agilent 34405A). The voltage on the tested component is calculated from generated DC level subtracting voltage drop on a serial resistor. The DO module can treat with out-of-range or mismatched received values. Measured data are added to internal arrays and shifted to GO module for displaying in a Graph tab. Sometimes it is need to clear previously measured arrays by pushing ***Clear Data*** button. Pushing ***Listing*** button displays data arrays in Listing tab of the front panel. The graph is transmitted as an image if choosing corresponding control (***Image***). ***Help*** can be also shown as a picture in the Image tab (Fig. 4).

Typical application could be measurement of diodes. Measured V-A characteristic of a rectifier diode is shown in Fig. 3 right. Characteristic of a bulb can be seen in Fig. 3 left. Corresponding simulation application was also created allowing learning of the control of a workplace even if real measuring devices are not available. Today the software is used as supplementary aid. The feedback from teaching process is obtained over quizzes published in e-learning system Moodle [7]. Generally, the system allows sending data back to GO module

as a parameter of command. This could be employed also for sending the final measured values as an output of exercise, however this kind of feedback was not yet implemented in presented applications.

3. DC MOTOR SPEED MEASUREMENT

Other application added into our system is measurement of DC motor speed – Fig. 5, Fig. 6. Here the remote user controls voltage supplied from DC source (KEYSIGHT 3640A) to the motor input. Then the speed is measured by Optoelectronic Encoder MOM18. The encoder output is connected to analogue input of the DAQ measurement card PCI 6221A.

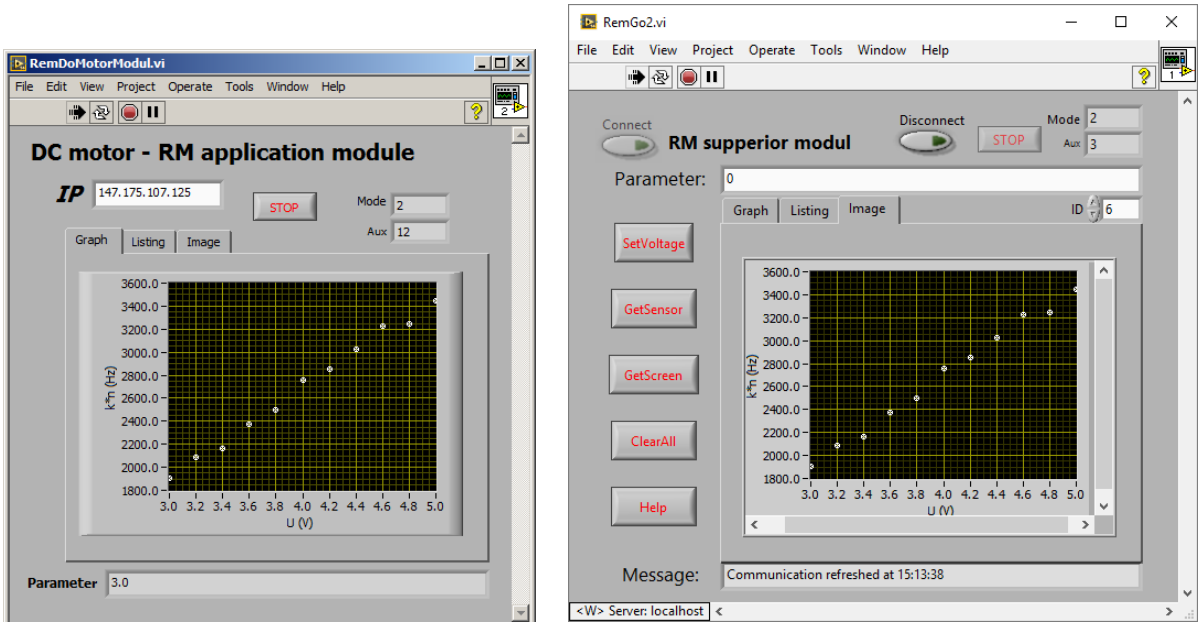

Fig. 5. DO and GO modules for DC motor measurement
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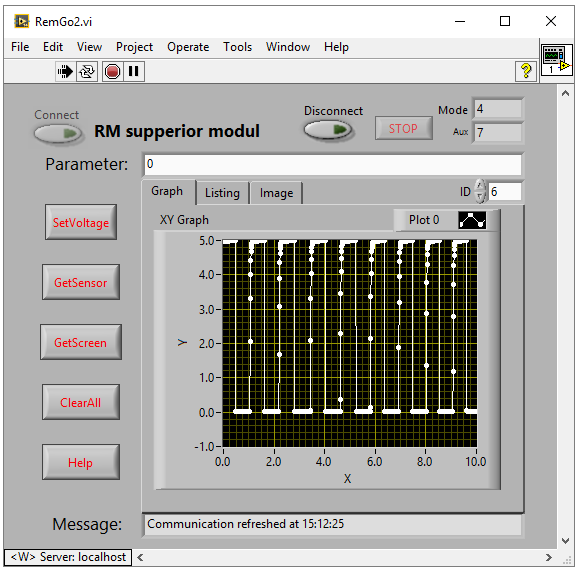

Fig. 6. Front panel of the GO module accessed directly
Source own

After starting the GO module and pressing the ***Connect*** button the connection is initialized. If the ***SetVoltage*** button in GO module is pushed the voltage value entered in *parameter* box is forwarded to DO module and then to the DC source over RS 232 interface. After short delay (cca 1s) instant measurement is accomplished. I.e. the speed is obtained by calculating frequency of optoelectronic encoder output connected to DAQ. Measured data are added to arrays and shifted to the graph in DO module and to the Listing tab of DO and GO module too. For displaying graph in GO module it is necessary to push the ***GetScreen*** button. The graph is displayed just as picture in Image tab (Fig. 5 right), where the vertical scale is not evaluated in final scale as RPM. This is the task for the student, who can obtain the encoder output waveform using

GetSensor button. Signal from encoder is then shown in Graph tab of the GO module front panel. Considering 100 pulses per sensor revolution, the waveform of frequency 900 Hz in Fig. 6 left (X-scale is time in ms) represents 540 RPM. By pushing ***Clear All*** button previously measured data are deleted from array and from graph in DO module. ***Help*** can be also shown as a picture in the Image tab.

CONCLUSION

New software system for remote access to experimental workplaces has been presented in the paper. It was designed in LabVIEW programming environment. The system has a modular structure. It is based on pairs of superior GO and target DO modules. The GO module is running on a special server PC and distributes measured data over the network using Remote Panel technology. Data Socket Server provides a way to share variables between pair of modules.

For testing of functionality of the system, several target applications were created. Three of them oriented on teaching of DC measurement skills have been presented – two controlling real workplaces and one running as simulation of a measurement. The applications are just ready for deployment in educational process. They should support practical exercises for students who are not able to be present in the laboratory and offer wider working time. The remote laboratory experiments give students good possibility to do measurement experiments and to understand the rules. Every task is available all the time and students can use them whenever suitable. More similar applications will be integrated into teaching just shortly.

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Acknowledgement
The work presented in this paper has been supported by the Slovak Cultural and Education Agency under grant No. KEGA-016STU-4/2014 and by the Slovak Scientific Grant Agency No. VEGA 1 0431 15.

ETHICAL LEARNING BY USING AN E-LEARNING PLATFORM

Johann Krammer and Franz Feiner
Kirchliche Pädagogische Hochschule Graz
Lange Gasse 2, A – 8010 Graz, franz.feiner@kphgraz.at, johann.krammer@kphgraz.at

Abstract: *Communication is – in the author's opinion – an ethical category which is realized by face-to-face-communication on the one hand, and which may also be realized by ICT on the other hand. The authors see great potential in the ICT as a medium for philosophizing with children to develop ethical issues like self-esteem, justice, respect, tolerance and responsibility. This potential is illuminated by the EU-project ETHIKA.*

Keywords: values, ethics, philosophizing with children, face-to-face-communication, e-learning-course

INTRODUCTION

The paper deals with ethical learning for students aged 3 to 14. Based on Feiner's and Resnik's presentation about "Ethics and Values Education with the Use of ICT" in BRNO 2015 both authors would like to show the progress of the project ETHIKA, especially the e-learning-course for ethics and values education, which is installed in the platform of the German Institut for Learn Innovation (ILI) of the Friedrich-Alexander-University Nurenberg-Erlangen. The German member of the ETHIKA-team, Evelyn Schlenk, developed this course that is based on the educational tools of ETHIKA (www.ethics-education.eu).

The authors want to discuss how to teach values with the medium of the Internet – using educational materials which were developed in the EU-project ETHIKA: *Ethical Education in Primary and Pre-primary Schools for a Sustainable and Dialogic Future*. First, we will present the ethical challenges of living together.

The aim of our research is to find answers to the following questions:
- Is it possible to support ethical education with ICT and is there a good chance of success with this method?
- When taking a look at the tools of the EU-Project ETHIKA we ask whether the tools are productive simply for working alone with a PC or the internet, or whether holistic methods such as Philosophizing with Children or biographical learning can be integrated …
- What is the role of the educator / teacher? Does he/she just give the input (link to the e-learning-course) or is he/she personally important in the educational process?
- Will the e-learning course show that ethical learning is an essential way of social learning and that it only can be realized in a processes of interaction and communication with others?
- Does ICT just foster individualism or can ICT in ethical education contribute to more "connectedness"?

1. ETHICAL CHALLENGES OF LIVING TOGETHER

"Our society is going through rapid and profound changes due to globalization processes, closer integration and the expansion of the EU, economic crises , advancement of technology and social innovation, migrations and challenges to traditional identities and memberships,

etc. All of these societal transformations present the educational sector and especially education professionals with new challenges. The development of a knowledge-based society and the globalization process are creating new social and individual needs in the areas of culture, scientific and technological development, social cohesion, education, the position and the role of an individual as a citizen as well as in the area of an individual's personal development" (Ćurko, Feiner, Gerjolj et. al. 2016, 5).

2. FROM EGOISM TO CONNECTEDNESS

Although there exist – also in 21st century – a lot of wars, violence and egoism, the most important neurobiologists are convinced that mankind is progressing in its development towards „connectedness" (Hüther – Spannbauer 2012). Hüther sees great progress and readiness of a growing number of people to work for a better world, for more communication and for a better environment.

In opposition to the neo-Darwinian Dawkins, who talk about an „egoistic gen" (Dawkins 2004), one of the most important German neurobiologists , Joachim Bauer, explains that people are not only created for competition and 'survival of the fittest' but rather more for cooperation, communication, and creativity (Bauer 2008). An example of this theory is the traffic on the streets: Normally no one wishes to kill another person on the streets; accidents happen without purpose. The neurobiologist Bauer also explains that DNA is constructed in pairs; in this fact he sees the biologic basis for living together and communication ...

3. TOOLS, DEVELOPED IN THE PROJECT ETHIKA

The project ETHIKA provides a chance to realize value based-education. Its tools for ethical education in primary and pre-primary schools for a sustainable and dialogic future address the needs of primary, lower secondary and pre-primary school-teachers and other educators and offer them lifelong learning opportunities in ethics education, employing dialogical (philosophy with children) and integrative (holistic) methodology and approach. The main outputs of the projects are educational materials and tools for teachers that are prepared in relation to the previous user needs analysis. They have been previously tested in piloting activities and test-beds by teachers and other educators in classrooms. The core motivation for the projects was awareness that the challenges that the EU countries and the rest of Europe are facing now are not merely economic or political, but also societal, cultural and especially ethical.

The main objectives of these projects are to provide effective lifelong learning possibilities for teachers and educators in the field of ethics education; to develop, promote and disseminate teaching methods, materials and tools; to stimulate the rise in the level of ethical knowledge, awareness and critical thinking in schools (teachers, educators, students, parents), as well as to provide a wider support network (organizations, experts, teachers) and advocate ethics education (policy and decision makers).

3.1 User Needs Analysis (UNA) of ETHIKA

By using an online survey for teachers it was discovered that teachers in six European countries who were surveyed have similar needs and expectations concerning:
a) topics they consider most relevant for ethics education;

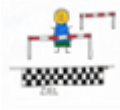
b) thematic aspects for which they would like to have educational material and tools developed.

The results of the ETHIKA-UNA in all six participating countries illuminate these themes: self-esteem, honesty, appreciation (as the psychological basis for communication), dialogue, relationships, respect, friendship, conflict solution, cooperation, responsibility, moral values, justice, acceptance, empathy, compassion, (as very important values in dialogic pedagogy) (presented by Evelyn Schlenk [Friedrich-Alexander University (FAU) Erlangen-Nürnberg] at the 1st ETHIKA teacher training in Ljubljana on February 23rd 2015). Based on these answers from the focus group the researchers of ETHIKA have created a shortlist of five key ethical topics: self-esteem, justice, respect, conflict resolution and responsibility.

In general we can say that teachers perceive the importance of communication in ethical learning processes.

3.2 Holistic educational tools

ETHIKA researchers developed thirty tools relating to the six topics for differing age groups originally formulated in the User Needs Analysis (UNA) – see overview. All of these tools are based on the holistic approach of Howard Gardner's concept of multiple intelligences.

Age	Conflict resolution	Ethical actions	Justice	Respect	Responsibility	Self esteem
3-5	 Who is faster?	 Overcoming obstacles	 Tomato's feelings	 The speeches round	 Pumpkin signs	 Puppet's problems
5-7	 Sign choosing	 Cooperative games	 Sad Broccoli -- > *PowerPoint*	 Elf's box	 Story about Peter	 Daddy is a superhero
7-9	 We all like our logo	 Civic action	 Unfair Rain	 Why do we need to respect others? -- > *PowerPoint*	 A Girl and a Dog	 Try to find positive
9-11	 Making Peace	 Code of ethics for volunteers	 What is justice? -- > *PowerPoint*	 Step forward	Superheroes --> *PowerPoint*	 Just be you!

11-14	 Listening and communication skills	 Charity club for a better world	 The mathematics exam	 The debate and the Jury	 A poem for a better world	 Picture workshop

Fig. 1. ETHIKA educational tools – description in English, Icons © Mojca Resnik
Source: own

All of these tools were then tested in piloting and test-beds activities. A project website with basic information about the project and its results is reachable at: http://www.ethics-education.eu/; Facebook page: www.facebook.com/ethicseducation.

ETHIKA tools can be downloaded. The Creative Commons license permits the free use. The set of educational tools developed by the ETHIKA project is presented in Figure1, according to the age of the children and the topic of interest.

3.3 Methods of the educational tools – especially face-to-face-communication

The Information and Communication Technology (ICT) supports face-to-face-communication and is very useful for philosophizing with children. The set of educational materials for the use of teachers and educators of children of different ages (ages 3-5, 5-7, 7-9, 9-11, 11-14) is presented on the internet. It can be used in the teaching process according to the Creative Commons Non Commercial Share Alike License  . One example is presented in this paper.

4. E-LEARNING PLATFORM

According to the wishes and expectations expressed by the teachers and educators in the User Needs Analysis (UNA), the ETHIKA teaching materials are not only available as text documents on the ETHIKA website, but have also been implemented as e-lerarning content for the German speaking community. At the Friedrich-Alexander University (FAU) Erlangen-Nürnberg, Germany, the ETHIKA e-learning course is available to all teachers and students on the central learning platform “StudON”, and therefore can be used e.g. for teacher training activities. Additionaly the course was made available to the general public via the German ETHIKA portal https://ethik-unterrichten.de/. Access and use are free. The course modules are arraged by age groups and topics.

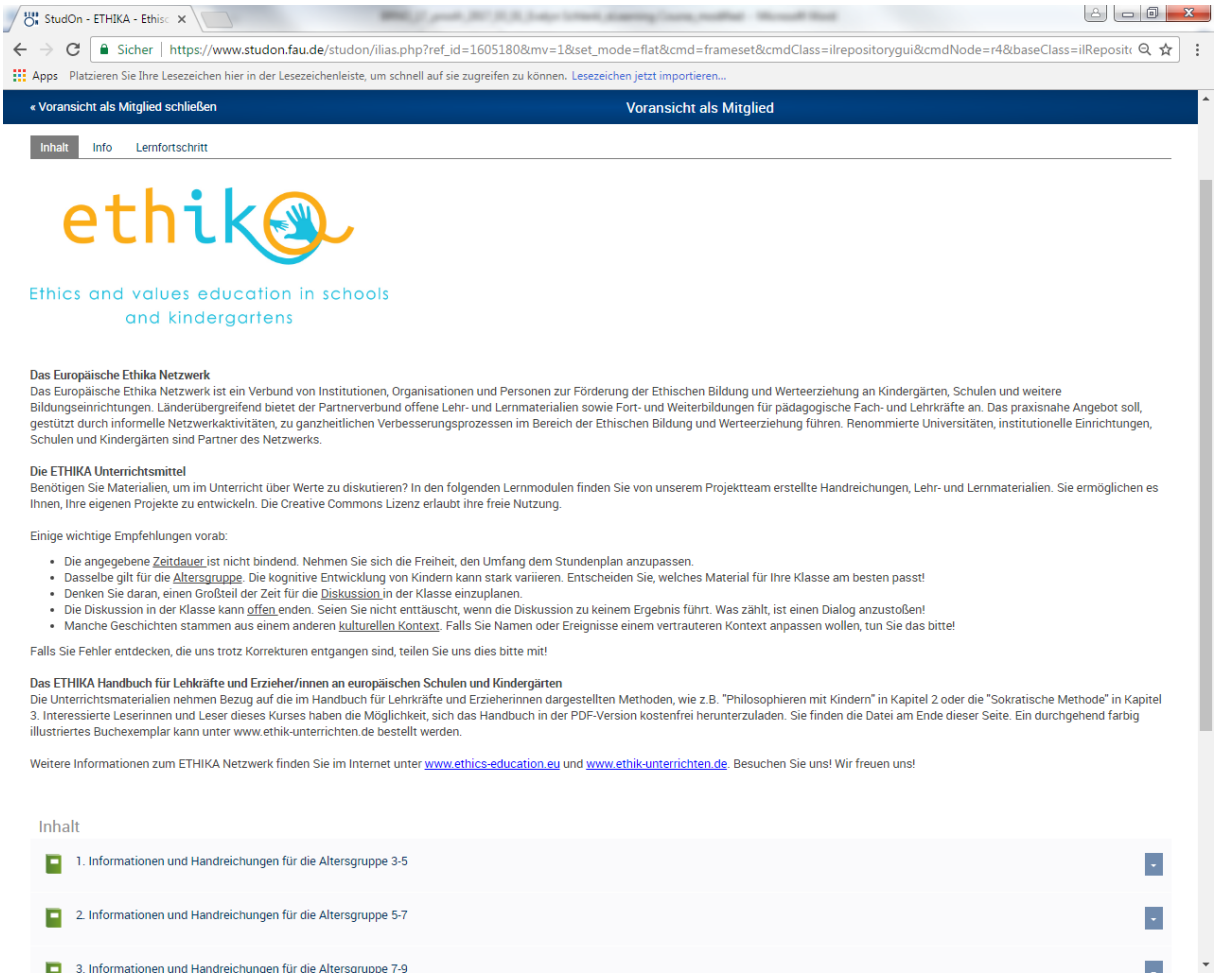


Fig. 2. ETHIKA-e-Learning Course on StudOn, the central e-learning platform of FAU
Source: Own

Example to the theme "conflict resolution"

In the tool "Who's faster" for 3 – 5 you can find the following goals:

"Key learning points: Encourage children to:

• think about their behaviour in conflict situations, even from an early age;
• learn to listen to one another;
• create awareness of themselves and of the "other" person, even from an early age;
• expand the repertoire of behaviour in conflict;
• find solutions and express their own attitudes in a creative and non-violent way;
• explore the concept of conflict resolution on an ethical and moral level;
• change attitudes towards conflict

The aim is to encourage children to think critically about conflict. Also, it is important for them to learn borders in conflict situations and to raise awareness of various ways of responding and resolving conflicts by getting to know their own dissatisfaction and learning to express it in understandable form. By expanding their repertoire of behaviour, we want to teach children to learn how to jointly find a solution to the conflict in a creative and non-violent way. This is an important starting point in shaping the children's attitude towards the conflict." (Teacher Manual 3 – 5 "Who's faster, p. 4)

These models focus on many skills which are not only cognitive, but also holistic and communicative social skills.

CONCLUSION

The project ETHIKA aims primarily to develop new and innovative curricula, open educational resources (OER), educational methods and training courses.
The project will enhance innovation and internationalization in the school sector and strengthen cooperation (capacity building); critical thinking will raise the level of key competences and skills and encourage active participation in society (Erasmus+; EU2020). The main objectives of the project are to provide helpful lifelong learning possibilities for teachers and educators using innovative methodology and integrative approach in the field of ethics education and especially to stimulate the rise in the level of ethical knowledge, awareness and critical thinking. The website of the project will be kept alive (www.ethics-education.eu), where all the educational materials and tools will continue to be freely accessible.

In our experience there is great potential in the possibilities provided by supporting ethical education with ICT.

In the EU-Project ETHIKA more than 30 tools for the age of 3-5, 5-7, 7-9, 9-11 and 11-14 were developed and can be found published in six languages on the ETHIKA-website; all materials are for free use. The E-learning course is under construction and will be opened for all interested users in a few months.

- When we take a different look at the material, we can point out that there are opportunities for integrated holistic methods, Philosophizing with Children, biographical learning …

- The educator / teacher can use / download all of the tools, but he/she as person is the key to the educational process.

- Ethical learning is essential to social learning. Ethical learning can be realized only through processes of interaction and communication with others.

In conclusion, ICT in ethical education can contribute to more "connectedness" between small groups and in all of society and has the potential to address young people in a unique way.

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ADVANCED POWER ELECTRONICS IN E-LEARNING

Juraj Marek, Aleš Chvála, Peter Benko, Róbert Szobolovszký, Jaroslav Kováč jr. and Ľubica Stuchlíková
Slovak University of Technology in Bratislava, Faculty of Electrical Engineering and Information Technology, Institute of Electronics and Photonics
Ilkovičova 3, 812 19 Bratislava, Slovakia
juraj.marek@stuba.sk, lubica.stuchlikova@stuba.sk

Abstract: *Advanced power devices have strategic importance in the microelectronic and power industry. This paper presents authors motivation and experiences gained through creation of e-learning course named "Advanced Power Electronics". The course was prepared primary for general public, but it can provide useful knowledge also for high school scholars and bachelor students. Course highlights basic of power electronic devices, their main differences and important parameters. These information are complement with practical results obtained from measurements and Technology Computer Aided Design (TCAD) simulation. Main part of course is oriented on modern power devices based on wide band gap materials – III-N semiconductors.*

Keywords: e-learning, power electronics, Gallium nitride (GaN), High Electron Mobility Transistors (HEMT), Technology Computer Aided Design (TCAD) simulations.

INTRODUCTION

Power semiconductor devices are recognized as key components of all power electronic systems [1]. For the design of innovative products in the microelectronic industry, especially in the area of power electronics, the availability of the most recent knowledge is mandatory [2]. Construction wise, a power device is quite different from a standard electronic device where silicon dominates. The present status of the research, development and/or commercialization, as well as cost-effectiveness of smart power devices and integrated circuits using wide bandgap semiconductors in advanced energy efficient electronics systems is on so high level that gallium nitride (GaN) become standard power electronic device material [3]. Also power carrying capabilities voltage rating, size, frequency, thermal ratings and duty cycle of power devices are much different than standard devices and strongly depend on used materials [4, 5, 6]. For wide society it is important to point out importance of new research in this area and highlight benefits that new technologies bring like higher efficiency and lower losses of modern power systems. Researchers and authorities perceive that there is a huge gap between high level research achievements from scientific projects and wide non- or low-technical public. There are many ways how to change this state, and one of them is dissemination of experimental work using modern resources such as e-learning courses on internet. Our institute is currently involved in several scientific projects (e.g. OSIRIS, PowerBase...) that receive support from the European Union's Horizon 2020 research and innovation programme. One of the goals in PowerBase project is to prepare special e-learning course named "Advanced Power Electronics" oriented primary to general public (low-technical) and also for high school scholars and bachelor students. Course has to provide basic information about power devices, highlight main differences and important parameters of power vs. regular devices. The scope of this paper is to introduce this new e-learning course "Advanced Power Electronics" [7] prepared and located on portal "eLearn central".

1. E-LEARNING COURSE "ADVANCED POWER ELECTRONICS"

The e-learning course "Advanced Power Electronics" (Fig. 1) offers information about basics of power devices and GaN based High Electron Mobility Transistors in a way that most of the young students and low-technical public should understand. We have no information about open e-learning course dealing with advanced power electronics that is suitable for our target group. Accessible courses are especially designed for bachelor and master students [8] or are more specific in topic [9]. The main aim of the course is to introduce basic information about power devices and also provide detailed information about present research in the field of microwave and power electronics.

Fig. 1. Visitor´s view of the Introduction section of the "Advanced Power Electronics" course
Source: own

1.1 The course content

The course is divided into two main parts: Power devices basics and GaN based power devices. The first part has three sections – Introduction, History and trends, and Power MOSFET devices.. This part of course focus more on some specific areas connected with basic concepts, basic characteristics, simulations, power devices operation in detail, e.g. turning on/off process, inductive load switching, and second breakdown and still maintain the compactness of course. Second part has two main captions - HEMT and Future applications. This part contains basic explanation of HEMT function and applications with a short introduction to its invention and history in a way that should be understandable for general public.

The first lesson introduces the aim of project PowerBase and describes motivation for research and usage of power devices followed by lesson about the history and trends of power devices. Third lesson provides a basic introduction to Power MOSFET devices operation, concepts, design and applications. Fourth lesson provides a basic introduction to HEMT operation and close insight into the physics of 2 dimensional electron gas (2DEG) formation together with explanation of various types of HEMTs. The electrical properties of HEMTs are described and appropriate electrical characteristics are shown. This lesson is also dedicated to construction of real devices supported by simulations of new and perspective devices. In this lesson there are also described materials and technologies used for fabrication of these devices and discussed challenges in growth technology. The end of this lesson describes the implementation of HEMTs into circuit systems. The course is finished in sixth lesson where future power devices applications are introduced with short conclusion followed by References. On the end of each part are links that can be used to download simulation decks with short description and explanation of simulated characteristics and phenomena.

1.2 Learning Environment

The interactive e-learning course “Advanced Power Electronics” (Fig. 1) had been developed in education portal “eLearn central” environment based on Moodle 2 platform. Moodle (Modular Object-Oriented Dynamic Learning Environment) is dedicated to support e-learning and socially constructive frame of teaching. It is designed using these reasonable pedagogical principles, to help educators create fancy internet-based courses and web-based learning sites [10]. Moodle is free, online Learning Management system - open source software (under GNU Public Licence) and it offers various features and activities to be the best tool for management and learning promotion.

1.3 Book like appearance and navigation elements

Based on good experience from recent courses authors decided to create interactive course with many interactive elements and illustrative diagrams and pictures [8, 9, 11]. Moodle Module Book has been exploited, which produces a feeling that the student is browsing a book. Each lesson consists of educational materials (texts, figures, equations, simulations, animations and diagrams) arranged in form of slides. Students can easily browse through course using next/previous buttons or navigation panel on left side of screen (Fig. 1). Each page of course is not longer than two regular screens in order to keep slides compact to maintain attention of students. Icons are used for identification of individual lessons or for the marking of interesting information. This icon has been designed especially for portal “eLearn central”. Particular phenomena are visualized within possibilities – supplemented with

adequate pictures, graphs, simulations and micro-animations. Navigation bar offers the whole content of the course up to second level of structuring.

1.4 Interactive animations and example of simulations

However, structures of modern power devices may consist of several material layers and understanding of their internal operation may be quit difficult. One of the best ways to tackle this problem is to use animation, computer modelling and simulation. Interactive animations about HEMT embedded in course were created in Adobe Flash software as a collection of 7 micro-animations [12], which are linked by interactive list of contents. Each micro-animation is also exploited in course individually as a part of education text. In the Fig. 2 examples of micro-animations are shown. First example is common source transistor transfer characteristics and second is HEMT application in switch for radar.

Fig. 2. Interactive micro-animations: common source transistor transfer characteristics (left) and HEMT application – in switch for radar (right)
Source: own

Numerical modelling and simulation are very effective educational tools for a better understanding of the electrical characteristics of analyzed semiconductor devices. Parts of the course are simulation decks. Enclosed simulation decks can be used in Synopsys Technology Computer Aided Design (TCAD) system [13]. The simulation of real devices makes a different inside view of real devices. There are several simulation examples - packages in course – basic characteristics for Si MOSFET and GaN HEMT, Switching of inductive load, Impact of defects on HEMT characteristics, Thermal management of HEMT and Impact of interface charge on characteristics of HEMT. To use this package user must be logged to one of our servers and has an account with access rights to simulating tools. This restriction was done due to limited amount of licenses for students and employees on our institute and to control unauthorized use of our TCAD tools. After downloading a deck, and opening it in Synopsys Genesise program user will find complete project with prepared structure models. Each input file is described with comments. Parameters recommended for alternation are highlighted in input files and are also easily reachable from workbench from where full control of project is done. In Fig. 3a user view of project is shown. Fig 3b shows simulated current density. Parameters like electric potentials and fields, currents and charge densities can be easily visualized. Using Inspect program graphs of simulated physical quantities can be plotted (Fig.3c,d). Exploiting of simulations in e-learning course is considered as an alternative for the learner to gain detailed idea about what happens inside HEMT structures during its operation. This information cannot be obtained just by a simple observation.

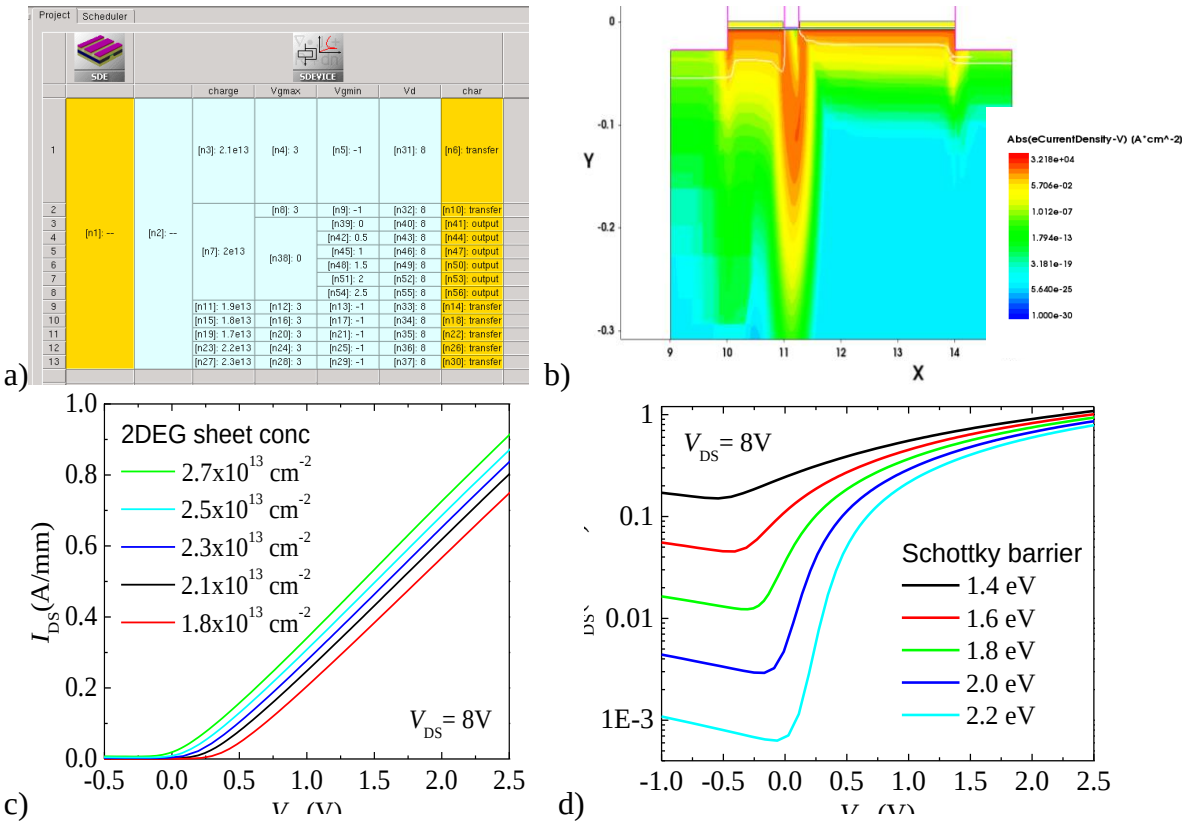

Fig. 3. a) User view of TCAD project template b) Current density distribution for V_{DS} = 8 V and gate voltages V_{GS} = 0 V. c) Influence of 2DEG density on the transfer characteristics. d) The influence of Schottky barrier high on transfer characteristics.
Source: own

CONCLUSION

Advanced power electronics represents an important segment of the semiconductor industry worldwide and is generally characterised by devices with high strategic importance. Concurrently modelling and simulations are very popular among students, because they allow very easy and more illustrative explanation of internal behaviour of electronic devices. In this contribution an interactive e-learning course named "Advanced Power Electronics" has been introduced. The main aim of the course is to present new technologies and concepts of advanced power devices to wide audience in friendly way. The course combines theoretical basics with corresponding results from Technology Computer Aided Design simulations. English-language version of the course is accessible for the public from May 2017. It is also implemented in blended study of bachelor programs at our faculty. The authors are sure, that e-learning has potential to be an excellent tool for transfer of knowledge, research results and latest findings into the education process and also for popularization of Science and Technology.

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Acknowledgement
This work has been supported by project 'PowerBase'. This project has received funding from the Electronic Component Systems for European Leadership Joint Undertaking under grant agreement No 662133. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation program and Austria, Belgium, Germany, Italy, Netherlands, Norway, Slovakia, Spain and United Kingdom. Also support from Ministry of Education, Science, Research and Sport of Slovakia under grants KEGA 020STU-4/201515 and APVV-14-0749 are kindly acknowledged.

A COOPERATIVE APPROACH TO DISTANCE LEARNING IN RADIOBIOLOGY

Vladimír Mašín[1], Martina Řezáčová[2], Jiřina Vávrová[3], Petr Paluska[4], Martin Kopeček[1], Petr Voda[1], Josef Hanuš[1]and Pravoslav Stránský[1]

[1] Department of Medical Biophysics, Faculty of Medicine in Hradec Kralove, Charles University, Simkova 870, 500 03 Hradec Kralove, Czech Republic, masin@lfhk.cuni.cz

[2] Department of Medical Biochemistry, Faculty of Medicine in Hradec Kralove, Charles University

[3] Department of Radiobiology, Faculty of Military Health Sciences, University of Defence

[4] Department of Oncology and Radiotherapy, Faculty Hospital in Hradec Králové

Abstract: *Radiobiology is an important discipline both in civilian and military medicine. It is also a highly complex field, combining topics from basic physics to clinical oncology and radiotherapy. This level of complexity made it quite unpopular among pre-graduate students and difficult to grasp for teachers from any single department at the same moment. We attempted to overcome these difficulties by combining strengths of multiple departments, which cooperated to author a single e-learning course. Each chapter includes a brief self-evaluation test, which can be used by the students to assess their progress in understanding of the given topic. Our e-learning course became the fundamental study material of a new elective subject, taught at the Faculty of Medicine in Hradec Králové, which has proven to be surprisingly popular among pre-graduate students of the 4th and 5th study years.*

Keywords: e-learning, radiobiology, biophysics.

INTRODUCTION

Radiobiology is a very important discipline both in civilian and military medicine. It is nowadays regarded as a multidisciplinary field, because it combines together topics from nuclear physics, physics of ionizing radiation in general, radiation chemistry, molecular biology, biology at the cellular, organ, and systemic levels, and clinical oncology and radiotherapy.

Historically radiobiology formed the core part of medical biophysics courses at all medical faculties, but over time the focus of these courses had to significantly widen due to introduction of many new medical devices, new materials, and diagnostic or therapeutic method based on physical principles; in the last several decades also a significant part of time originally dedicated to medical physics had to be used for explanation of information technology topics. Our own department of medical biophysics, established in 1945, was originally focused mainly on radiobiology; nowadays we cover both in teaching and research many other fields as well, starting from mathematical statistics and applications of statistics in medicine [1, 2] through mathematical modelling of apheresis procedures [3-4], applications of shape memory materials in general medicine [5] and dentistry [6] up to inclusion of modern teaching method based on applications of information technology in medical education [7-9]. The radiobiology itself in the same timeframe significantly expanded and branched out as well, and today its scope is so wide that it is virtually impossible for any

single department to cover it. Inevitably teaching of radiobiology had to be reduced to the very basic principles – it has to be explained in just 6 hours of lectures in our course of medical biophysics in the first year of medical studies now. This reduction of teaching hours together with its intrinsic level of complexity made it quite unpopular among our pre-graduate students.

Because of all these reasons we decided to cooperate with several other departments involved in all areas of the field of modern radiobiology and together we authored a single comprehensive e-learning course. The Dept. of Medical Biophysics created the physical topics of the course covering structure of matter, radioactivity and other sources of ionizing radiation, types of ionizing radiation, physical interactions of ionizing radiation with matter, and dosimetry of ionizing radiation. Our colleagues from the Dept. of Medical Biochemistry are actively involved in research of molecular mechanisms of radiation effects [10] and therefore were properly qualified to add a chapter about molecular mechanisms of biological response to ionizing radiation. The colleagues from the Dept. of Radiobiology described the effects of radiation on human organism, and the mechanisms of its response, which are the main part of their own research activities [11], and the medical physicist from the Dept. of Oncology and Radiotherapy enriched the course by adding the clinical point of view, covering applications of ionizing radiation in therapy of various medical conditions. Our e-learning course became the fundamental study material of a new elective subject, taught at the Faculty of Medicine in Hradec Králové in the 4^{th} and 5^{th} study years since the academic year 2015/16.

1. TOOLS AND METHODS

Our e-learning course is mostly based on e-learning activities available in the open source Learning Management System (LMS) Moodle 2 (www.moodle.org, managed by Moodle Pty Ltd, West Perth, Australia).

It also includes illustrations and animations created in Microsoft® PowerPoint™ 2010 (Microsoft Corp, Redmond, WA, USA) and converted into web page friendly format through the iSpring Presenter program (iSpring Solutions, Alexandria, VA, United States). Statistical analysis of the test results was performed in NCSS 2007 (NCSS LLC, Kaysville, UT, USA. www.ncss.com); Kruskal-Wallis One-Way ANOVA on Ranks statistical test had to be used because the test results were discrete variables and therefore unsuitable for simple one-way ANOVA testing.

2. COURSE STRUCTURE

The schedule of the radiology course consists of two contact seminars (the first one serves as the introduction into the subject and explains the history of this discipline; the other one is closing the whole course and is dedicated to discussions on its topics) and eight e-learning lessons. Each e-learning lesson contains two Moodle activities – first a "book" activity explaining the topic, often using various types of illustrations and animations (see examples further in the text); then follows the "test" activity verifying how much information were the students able to retain using a multiple choice test (each test attempt consists of five to ten different questions, which are randomly selected from the test bank; the order of the suggested answers is reshuffled in each attempt as well).

2.1 Structure of matter

The first e-learning lesson explains the current theories describing fundamental structure of matter – the Standard Model of elementary particles, and their fundamental interactions. The main purpose of this lesson is to introduce students into the field of physics of elementary particles and give them basic understanding of concepts used in the following topics.

2.2 Radioactivity

The second lesson is discussing the most frequently occurring types of radioactive decay, their physical causes, the types of radiation produced in these decays, and the basic physical laws governing these processes, such as the law of radioactive decay or the law of radioactive equilibrium. Also included are the most important examples of natural and artificial radioisotopes; in the latter ones the nuclear reactions used in their production are mentioned as well.

2.3 Interactions of ionizing radiation with matter

The third chapter is dealing with the modes of interaction of ionizing radiation with matter, which are relevant to conditions observed in biological systems. These interactions are first classified into four main groups (interactions of light charged particles, interactions of heavy charged particles, photon interactions, and neutron interactions), and the most important modes of interaction for each group are discussed thoroughly. Special attention is given to the relations between the ways how each type of radiation is interacting with matter, and its biological effects.

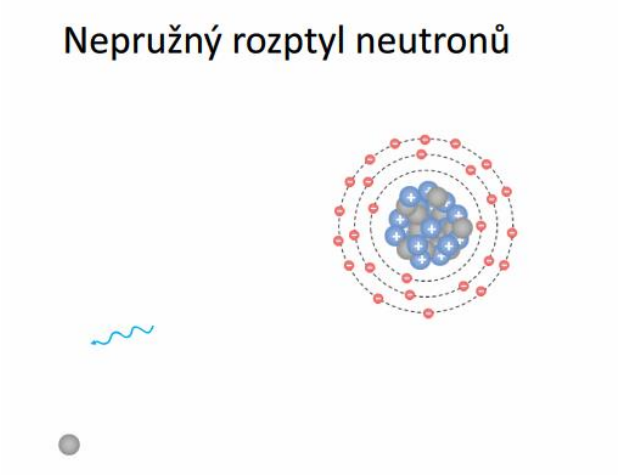

Fig. 1. Incoherent scattering of neutrons on atomic nuclei
Source: own work (Vladimir Masin)

2.4 Overall biological effects of ionizing radiation

The fourth part of the course is starting with the basic classification of the biological effects of radiation (direct vs. indirect mechanism; stochastic vs. deterministic effects), and follows with description of the typical course of various forms of the acute radiation syndrome caused by total body irradiation, and characterization of typical effects of localized irradiation of various body parts, including real cases observed in the notable historical radiation accidents.

2.5 Molecular mechanisms of biological response to radiation

The fifth lesson is focusing on the repair processes running in the cells at the molecular level, and their involvement in repair of damage caused by ionizing radiation. Special attention is payed to the mechanisms providing repairs of DNA break (both single-strand and double-strand ones), to the role of the p53 protein in these processes, and to the pathways leading to induction of programmed cellular death (apoptosis), which provide the mechanism of the last resort for the severely affected cells.

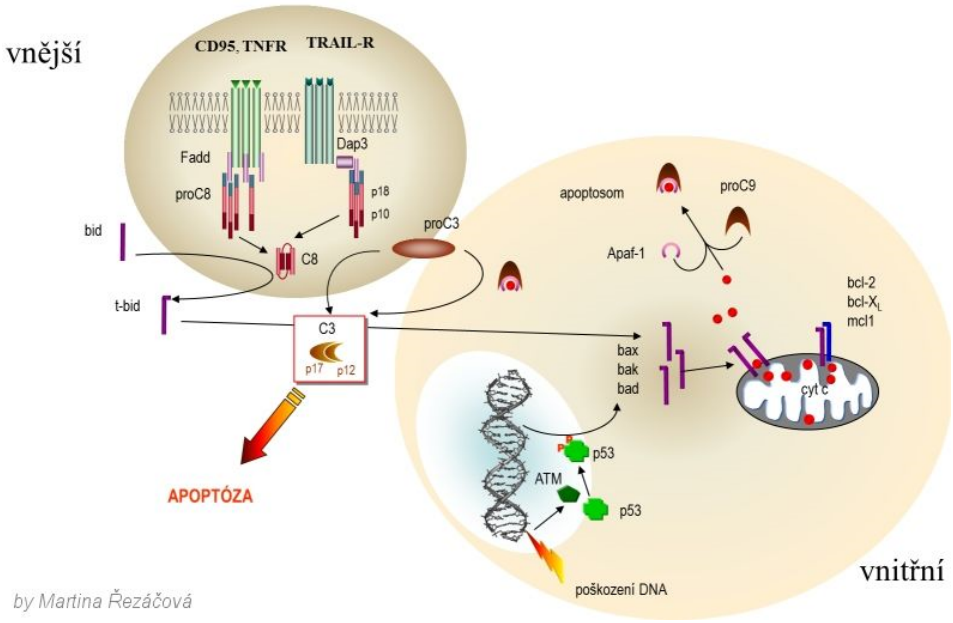

Fig. 2. Mechanisms of apoptosis activation
Source: own work (Martina Rezacova)

2.6 Sources of ionizing radiation

The sixth chapter is opening with classification of the sources of ionizing radiation according to their significance (which is important for radiation protection), and then discusses in detail the most important types of radiation sources (both natural and artificial) with the special regard to the sources important for radiation hygiene and medical applications (significant radionuclides such as ^{222}Rn, ^{131}I, ^{99m}Tc, ^{18}F and their production; X-Ray tubes, linear accelerators, cyclotrons, and nuclear reactors).

2.7 Dosimetry of ionizing radiation

The penultimate part of the course is dedicated to dosimetry of ionizing radiation, and is divided into two parts – the first one is defining the physical quantities and units used to describe the sources of ionizing radiation, propagation of the radiation through the space, its effects on matter, and finally its biological effects. The second part of this chapter then discusses physical principles of the most important types of devices used to detect and measure ionizing radiation – dosimeters.

2.8 Therapeutic applications of ionizing radiation

The final chapter of our e-learning course is focused on radiation therapy, starting with the description of the radiation sources used in modern radiotherapy and the techniques of their use (external vs. internal irradiation; photon vs. hadron therapy; advanced radiotherapy planning techniques and computer programs), and following with explanation of biological principles of radiotherapy (radiation sensitivity of the tumors and healthy tissue surrounding them as illustrated in the Paterson-Parker dosage system, and importance of dose fractionation for improved tolerance of healthy tissues).

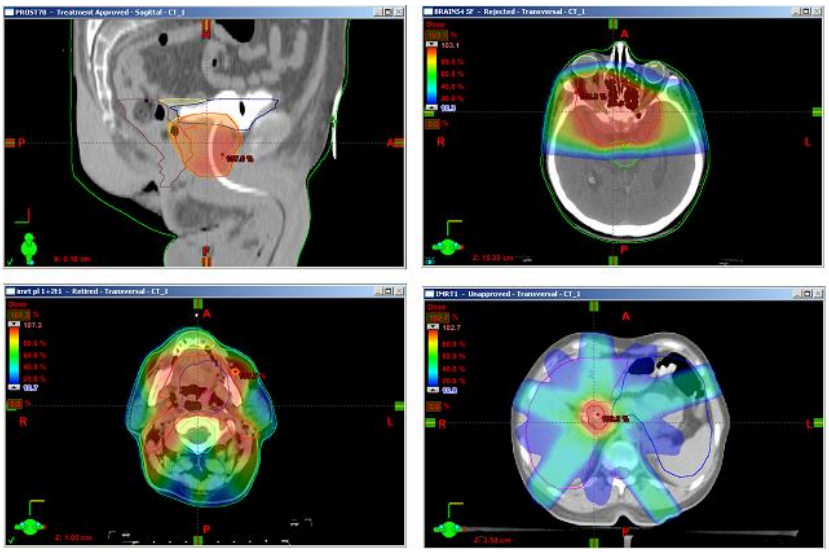

Fig. 3. Examples of Intensity-Modulated Radiation Therapy (IMRT) planning
Source: own work (Petr Paluska)

3. RESULTS

The single most important result from our point of view is the number of students enrolled into this new elective subject, which is showing a growing trend (from 16 students in 2015/16 to 27 students in 2016/17), although the sample is still too small for any statistical analysis.
We also tried to perform a statistical analysis of internal consistence of our course, based on the test results from 2015/16. Medians of the students' scores (normalized to maximum of 10 points for each course, n = 16) suggest a slight inconsistence – the first two topics look slightly easier than the rest:

Topic	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Median of points	8,7	9,2	7,5	7,4	7,4	7,2	7,8

Table 1. Median test results
Source: own

The last topic was excluded from analysis, as the number of test results was insufficient for it.

The statistical analysis confirmed our initial assumption – while the Kruskal-Wallis test performed on all tests proved difference of medians ($p = 0.02$), the medians of first two tests, as well as the medians of tests 3-7 showed no statistically significant difference ($p = 0.88$ and $p = 0.54$, respectively).

4. DISCUSSION

The initial experiences from practical application of this e-learning course suggest its good acceptance by the students; unfortunately it can't be confirmed by any feedback analysis, as the response rate was too low.
The test results point to a minor internal inconsistency, which should be easily solved in the next revision of the course.

CONCLUSION

We were able to demonstrate that e-learning tools can be successfully used in collaboration of multiple departments, aimed at authoring of teaching materials for highly complicated, multidisciplinary topics. Further evaluation of the usefulness and potential re-usability of the course should be performed after a better sample of student's feedback answers is acquired.

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Acknowledgement
This work was supported by the program PROGRES Q40-09.

WEB-ENHANCED PROJECT ENVIRONMENT – WRITING SPECIFICATIONS AND CREATING INTERACTIVE POSTER PRESENTATIONS

Iwona Mokwa-Tarnowska
Gdansk University of Technology
Ul. Narutowicza 11/12, 80-233 Gdansk, Poland, imtarn@pg.gda.pl

Abstract: *Students learning technical English in a web-enhanced environment have the chance to develop different necessary skills. Interactions structured around online activities can effectively prepare them for challenges they will encounter in their professional life. A web-enhanced ESP course can motivate young people to work collaboratively to produce sample specifications as well as posters, which can develop their creativity and knowledge of technological advances in the fields of their interest. By doing this, they learn in an active way, which allows them to start building different competencies necessary in the work context. They are also exposed to the use of Internet tools in education, as well as new learning practices. The ideas presented above will be supported by students' opinions and attitudes expressed in the surveys conducted at Gdansk University of Technology.*

Keywords: Web 2.0 tools, web-enhanced learning, ESP, collaboration.

INTRODUCTION

Over the last years web-enhanced learning has changed substantially. The focus has shifted from delivering a vast amount of information towards providing students with diversified forms of interaction. New web tools can be used to create a learning environment structured around different pedagogical approaches, which can result in improving the quality of educational outcomes. They can support academic education to make it responsive to the needs, expectations, learning styles of the new generation of students. Not only do they enable digital immigrants and digital natives [1] to interact with the text but they also provide them with functionalities that give plenty of opportunities to increase learning experience inside and outside the classroom.

The paper aims to show how to enhance ESP classes with web-based learning, how to create a project-based environment that can raise students' interest in technical English and increase their satisfaction, and how to engage them in an active and collaborative development of knowledge and skills. Moreover, it attempts to show how to prepare undergraduates for future challenges in the work context, and how to increase their professional competence through research and learning online. The presented hypotheses are supported by survey results and the observation of students' behaviour in class.

1. DEVELOPING DIFFERENT SKILLS IN A CONSTRUCTIVIST AND CONNECTIVIST ENVIRONMENT

Classes in which adult students are passive receivers of knowledge, in which they have only to reproduce what they have learnt make them bored, and cause them to lose interest in learning activities. Accustomed to a highly-interactive world of social media and to the

razzmatazz of the Internet, they seem to look for more excitement and variety in whatever they do in class. To satisfy their needs, educators are trying to establish a learning environment where they can actively create meanings, and share them with the teacher and the whole cohort. Activities in which students can solve real life problems, engage in an act of creation and use authentic resources full of interesting facts about technological advancements can enlarge not only their language competency but also their professional knowledge. Last but not least, they may help them become lifelong learners possessing diversified skills.

Following the constructivist instructional design of their classroom activities [2], the language teacher can engage students by designing project-based tasks stimulating active learning [3]. When working together to construct meaning, students improve their self-reflective skills. Through participating actively in creating knowledge, and accommodating new concepts to reorganise the conceptual system they have, they can stimulate their internal thinking processes to develop analytical and critical-thinking skills [4]. Working in an environment which has changed from strictly instructive to collaboratively active, course participants have the chance to improve communication skills they will supposedly need to succeed in the workplace. Such classes add value to language teaching that targets students of technical academies and universities, whose needs are more difficult to satisfy as there are a limited number of different level coursebooks structured around their specialisms. Moreover, the language teacher must be aware that their ownership of technical knowledge may be contested [5]. Thus, a control sharing strategy seems to be more effective for educators to use. Assuming the role of a facilitator, the language teacher can aim to encourage building new learning experiences through interaction, critical analysis and authentic knowledge development.

In line with connectivism, when working in a project environment, the teacher enables the students to see and investigate connections between concepts, ideas and fields [6]. Being allowed to choose what to analyse and use to produce new mental models, the project team are exposed to a realm of diversified opinions and altering points of view. This can prepare them to perceive learning as a multi-dimensional process, in which information itself is no longer the most valuable asset – it is the ability to find information, critically review it, accommodate it into mental schema and explore options in a collaborative effort that poses a learning challenge, and makes students well equipped in vital skills needed in the work context. A project assignment supported by Internet tools can allow developing knowledge and skills in many different ways: formal, informal and non-formal.

2. WEB 2.0 TOOLS SUPPORTING ESP PROJECTS AT GDANSK UNIVERSITY OF TECHNOLOGY

Different Web 2.0 tools [7] can be used to enhance ESP classes for students of technology and engineering. The ones that support collaboration, communication, productivity and creativity, e.g., text based tools, image based tools and multimodal production tools can serve a number of purposes in a face-to-face classroom enhanced with online components. With their various functionalities, they can stimulate, through learning by doing, students' interest in developing professional English in authentic context and their engagement in acquiring new skills, as well as upgrading the ones they have.

2.1 Aims of Enhancing Traditional Classes with Web Technology

Over the last five academic years different short online components have been designed to enhance learning opportunities for students attending regular courses in English offered by the Language Centre at Gdansk University of Technology. They have aimed to introduce novelty into teaching and learning English for specific purposes, to prepare students for blended programmes and self-directed learning, and to teach them professional English in the context of their interest. The last few years have seen the emergence of different Web 2.0 tools, so an additional goal has been established, namely to test potential advantages of web-enhanced classes in developing language and non-language competencies, i.e., first of all collaborative skills but also analytical, critical-thinking and reflective ones. To achieve it, website creation and data publishing technologies such as the Moodle wiki tool and Thinglink have been chosen to support project-based tasks.

2.2 Design and Implementation

Since October 2015 my students have started developing online educational materials using different Web 2.0 tools. In the winter semester of the academic year 2016/2017, for the first time, two groups of Civil Engineering students attended web-enhanced classes structured around a curriculum including both interactive posters and wikis, which targeted English in an authentic context. Before that only one tool was always chosen to support a semester course. The students were divided into groups of three or four to work on each project.

The first project involved preparing an interactional poster using Thinglink. It aimed to supplement traditional materials from the first unit of Technical English 4. First, the students were to find information on accidental discoveries or inventions, and produce a multimedia poster. Then, they were asked to present it in class, deliver a short speech, and host a discussion based on it.

The second project was also based on the same coursebook, which includes tips on how to write specifications. However, it was considerably more creative than the first one. The students were asked to invent an apparatus or equipment, and provide its specifications in the form of a wiki in Moodle. All of them knew how to move around the LMS, as the university requires the first-year students to pass a test on how to use it, but they had not used its tools before. The second stage of the task was to advertise the product in class. It ended with a competition designed to increase student engagement. The task helped to move control over the learning process to the participants, as well as to create a positive atmosphere and the sense of community.

2.3 Research Methods

The qualitative and quantitative research into the nature of web-enhanced language classes at GUT and their impact on an increase in student competencies is in its initial stage and may include subjective results. Student's opinions and motivations shown in comments presented in class as well as open-ended questions will help to uncover trends to be further tested using quantitative research, which has just been initiated. Two basic tools were used to produce the qualitative analysis: direct observation and group discussions. The quantitative research involved a paper survey. The research questions were as follows: *What are the effects of using specific Web 2.0 tools on the students' perception of collaborative work and ESP*

development? and *What impact does using Thinglink and wiki have on collaborative and language skills?*.

It can be assumed that the composition of every study group was quite homogeneous with respect to many factors: age, intellectual capacity, interest in science and engineering. Moreover, all the respondents were regular BSc students of the same university, whose level of English ranged from B2 to C1 according to the Common European Framework of Reference for Languages.

2.4 Findings

The observation of the students' behaviour and after-the project discussions prove that the web-enhanced ESP classes were a good environment for project-based learning. The students enjoyed presenting their collaborative work. The outcome was very satisfactory in terms of language development. The productions included well-contextualised professional vocabulary and adequate grammar structures. The specifications were structured according to the principles of unity, coherence and cohesion. Not only had the writing skill improved but also the speaking skill was found to be significantly better in comparison with the students' earlier productions based on individual work and coursebook activities. It can be presumed that the students were also better at analytical reading as their texts exhibited high competency in information literacy. There has also been an increase in collaborative skills as the second project was better executed and the in-class presentation showed a high degree of commitment from all the group members. Although they initially barely knew each other, they seemed to be able to communicate well enough to achieve a common goal, and this was visible in their showing a great sense of achievement and satisfaction with their outcomes.

The following analysis is based on the opinions from the questionnaires completed by the great majority of the Civil Engineering students (41 out of 46 attendees) who attended my traditional classes during the winter semester of the academic year 2016/2017. Most of the students had never before used any online collaborative or data production tools on any course, which they stated in their questionnaires. Only two respondents had learnt English from online tests before they started attending the regular course in technical English, so they had some experience using an e-learning environment. Due to the limited scope of the paper, only responses to eight out of seventeen questions are presented below.

In the survey the respondents stated that Thinglink could support learning English quite effectively – the Yes and Rather yes answers constituted 66.51 % (Table 1). The majority of the oral presentations were of high quality and the students were enjoying both delivering and discussing them, which was easy to notice. A vast number of the respondents (80.49 %) regarded Thinglink as a good tool in collaborative work.

Thinglink	Yes (%)	Rather yes (%)	Rather no (%)	No (%)	I don't know (%)
Can Thinglink support learning technical English?	17.73	48.78	14.63	12.2	7.32
Is Thinglink a good tool to support collaborative work?	43.9	36.59	7.32	4.88	7.32

Table 1. Making interactive posters using Thinglink, academic year 2016/2017
Source: own

Almost 70 % of the respondents saw an increase in their language skills after creating a wiki, the reason being that they had to write a text in formal English and use appropriate technical vocabulary in the specifications context. Slightly over 80 % of the students thought that the Moodle task was an interesting addition to traditional learning (Table 2).

Wiki in Moodle	Yes (%)	Rather yes (%)	Rather no (%)	No (%)	I don't know (%)
Did the specifications task in Moodle enable you to develop your language skills?	19.51	48.78	12.2	12.2	7.32
Was the Moodle specifications task an interesting addition to traditional activities?	53.66	26.83	9.76	7.32	2.44

Table 2. Writing specifications using the wiki tool in Moodle, academic year 2016/2017
Source: own

Table 3 shows that 80.49 % of the respondents agreed that both tasks helped them increase their collaborative skills. Only one student chose the No answer and explained that he preferred individual assignments while learning a foreign language. According to the great majority of the respondents (95.12 %), an academic language course could be a good environment for developing collaborative skills. Their very positive attitude seems to have been influenced by the enhancement of the traditional classes with the web 2.0 tools.

Collaborative work	Yes (%)	Rather yes (%)	Rather no (%)	No (%)	I don't know (%)
Did the project tasks allow you to improve your collaborative skills?	29.27	51.22	17.07	2.44	–
Can developing collaborative skills take place during language classes at university?	68.29	26.83	2.44	2.44	–

Table 3. Collaborative work in an online environment, academic year 2016/2017
Source: own

The students also saw the opportunities that web technologies and collaboration could give for learning technical English (Table 4). As many as 80.48 % of the course participants found the web-enhanced classes attractive, and 78.05 % thought that online task would help them learn technical English. The students who did not like this environment did not provide any explanation. However, they were the respondents who did not particularly like the project assignments and did not find their English improved either.

Online tasks and learning technical English	Yes (%)	Rather yes (%)	Rather no (%)	No (%)	I don't know (%)
Are web-enhanced language classes an attractive way of learning technical English?	41.46	39.02	9.76	2.44	7.32
Can online collaborative tasks improve your knowledge of technical English?	34.15	43.9	4.88	14.63	2.44

Table 4. Impact of an online environment on learning technical English, academic year 2016/2017
Source: own

The survey results presented above are in line with the ones obtained in the earlier semesters [8]. The previous stage of the research, however, targeted language students' behaviour in e-learning and web-enhanced environments in general, and not online collaborative work in particular. Moreover, none of the respondents who participated in the research last year used both the wiki tool and the Thinglink one, so their experience was different.

CONCLUSION

On the basis of the qualitative research and the initial stage of the quantitative one it can be assumed that university students approve of using different web tools to carry out projects. An innovative learning environment may facilitate acquiring new knowledge and various skills in a more attractive way. Web 2.0 technology can support project work structured around constructivist and connectivist ideas, which will result in the students developing collaborative skills, and presumably other soft ones as well, e.g., social communicative skills [9], as restructuring information to produce new mental models involves analysing, reflecting, critical thinking and meaning sharing. In comparison with activities which are behaviourist in nature, constructivist and connectivist, collaborative learning can be an attractive addition to an instructivist classroom [10]. The observation of the students' behaviour in class has led to the conclusion that the new generation of learners enjoy working in an environment in which they exercise more autonomy and where they can share control.

Thinglink can be a valuable tool that provides authentic cultural input. Through the integration of text and visual media, it allows students to better comprehend what is being presented in class [11]. Besides, images make learning more interesting [12]. The research conducted by Wang and Vásquez shows that wikis evoked a more positive attitude towards co-operative learning among the students who used them. They also created the possibility of improving English, which was reflected in better performance in listening and reading [13]. Their findings can be supplemented with the outcome of the present study, indicating an important role of project work in an increase in the writing and speaking skills, which is in accordance with Bradley, Lindstrom and Rystedt's research results [14], showing that wikis foster the development of the writing skill and help to acquire linguistic accuracy. Thus, it can be stated that writing is no longer separate from other skills and is not taught in isolation [15]. This more integrated view of language learning can be supported by a web-enhanced environment.

Since using Web 2.0 tools on language courses for university students is a relatively new phenomenon, only limited research has been conducted on its impact [16]. However, it has already shown similarities in the way students of different faculties and higher education institutions perceive web-enhanced collaborative learning [17]. This may result from them being accustomed to using various technologies in many life contexts. The format of online activities may differ, but it is the inclusion of web tools that seems to add value to language courses for technically-minded students.

By adding variety to the curriculum, by creating a web-enhanced environment, educators can develop a programme that will better motivate students and engage them in developing professional competencies [18]. Such instructional design may contribute to raising the quality of teaching and learning, and to creating new opportunities to develop language competency and different soft skills, but this is an area that has to be researched further.

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BLENDED LEARNING IN PRACTICE OF E-LEARNING MANAGERS TRAINING

Nataliia Morze[1]**and Olena Kuzminska**[2]
[1]Boris Grinchenko Kyiv University, 18/2 Vorovskogo Str, Kyiv, Ukraine,
[2]National University of Life and Environmental Sciences of Ukraine,
Heroyiv Oborony Str., 15, Kyiv, Ukraine
n.morze@kubg.edu.ua[1], o.kuzminska@nubip.edu.ua[2]

Abstract: *The Web-based Instruction can open up (re)new opportunities for the development of educational environments. In fact, there is a variety of electronic learning (e-learning) environments that consider and combine different Information and Communication Technologies (ICTs) tools and instructional strategies; nevertheless, blended learning (b-learning) has been considered as "the most common mode of e-learning" in preparing future teachers. The article presents the results of experience teaching of masters Boris Grinchenko Kyiv University in pedagogical specialties by new specialization – «Management of e-learning». The authors see a great chance in use b-learning to training a new specialists pedagogic, to develop their professional, ICT and specific competences.*

Keywords: e-learning manager, competence, management of eLearning, pedagogical design, blended learning.

INTRODUCTION

Among the factors that influence the development of modern education are rapid change in technology and requirements of professionals; universal development specialist; integration of knowledge; development of collective learning. The educational situation decentered, established constant over many years of professional competence of teachers are beginning to change - along with subject competence becomes important ICT competence and training function is transformed into task to help student learning. The NMC Horizon Project can be regarded as education's longest-running exploration of emerging technology trends and uptake [1].

According to the research, most universities now actively are implementing e-learning [2]. The university set up IT infrastructure, functioning e-library, e-research centers, development e-environment [3] and investigated the issue of training in e-learning, e-science, e-democracy and implementation of e-management approach at the university environment [4]. However, not enough attention is paid to training teachers for the effective implementation of e-learning in the educational process to ensure quality education. The introduction of specialization «Management of e-learning» in the training of masters bring partial solution of this contradiction.

When selecting methods and techniques of training professionals – managers of e-learning, it is advisable to use blended learning technology. The aim of the present article is to substantiate and analyze results of the experimental study to use blended learning into the educational process of new Master's specialization, conducted on the basis of Borys Grinchenko Kyiv University.

1. TRAINING MANAGER OF E-LEARNING MODEL AND ITS IMPLEMENTATION

The experience of the authors on the implementation of e-learning, in particular Boris Grinchenko Kyiv University is a member of European University Association [2], as well as analysis of international and national experience [5] are the grounds for introducing specialization «Management of e-learning» for Masters enrolled in specialties «Pedagogy of high school», «Elementary Education", «Preschool education».

For description and justification of the learning process at a certain specialization, individualization and flexibility was developed a generalized model of e-learning manager (Fig. 1). This model is an adaptation of the model ICT competencies of teachers and developed on the basis of their corporate standards of masters [6], the framework of competence of e-learning for teachers [7] and approaches to the development of ICT competence of masters by authored article.

Fig. 1. Training manager of e-learning model, competence approach
Source: own

The main objective of creating a model (in this study are not allocated profiles of individual groups or participants) can be considered as the allocation basis for the development and implementation of educational influence. Factors that affect performance such effects include not only the adequacy phenomenon participants (willingness to implement the designed model), but also the resources of the educational environment and the implementation model of educational process.

The resource base of educational environment of Boris Grinchenko Kyiv University is sufficient for the effective implementation of e-learning as a tool for training masters – the future managers of e-learning. As a model of implementation of the educational process was selected blended learning technology as a promising educational technology on the one hand, and as an opportunity to demonstrate in practice its effectiveness to future teachers.

2. TRAINING MANAGERS OF E-LEARNING

2.1 Implementing blended learning models

Experience implementing blended learning in universities [8] is the basis for the selection of elements «mixing» in preparing future managers of e-learning [9]:

– full-time and distance learning (curriculum for training 50%/50%);
– user-generated content and foreign materials (including Microsoft Imagine Academy);
– self-study and collaborative learning (implementation of joint projects, such as e-learning environment of modern school);
– robotics and education (most masters have professional experience, so the work becomes a source of learning content and learning content is available on demand in the context of the need to perform work in the workplace).

As the base model to implement blended learning [10] was rotation model. Given the specificity of specialties, mostly used flipped classroom model. However, among those students were enrolled on an individual schedule, so partial implementation became model of individual rotation, where students take online courses, attending classes full-time or get online consultation. Each item of selected models (individual work, group work and work with the teacher) takes its role in accordance with Bloom's Taxonomy [11]. According to this taxonomy performed a selection of ICT tools.

2.2 Common approaches to designing courses for the study of subjects

Effective use of blended learning is not enough to move the materials of discipline in the electronic environment, special attention should be given to how to design e-learning courses and aspects of the educational process.

According to the authors, the design of e-learning course should be based on the principles of «backward design» [12]. Development of e-learning course does not begin on searching for content and development content of the subject by the relevant sector but to determine learning outcomes in the chosen discipline and selection of appropriate methods of assessment. Further determined the necessary resources (both components of information-educational university environment and external) and teaching strategies (including type of discipline): educational activities and scenarios of interaction between participants of the educational process in order to maximize involvement of students in virtual and classroom interaction. The last step is the selection and development of training materials. Properly designed e-learning course promotes individualization of the educational process, involvement of students to form their own initial contract trajectory, increasing motivation, accountability and student achievement in general. Selection of design technology [13] depends on the willingness of teachers and students to implement blended learning. However, the use of Blended Learning Toolkit [14] recommended for use as teachers and students (for example, to design their own courses).

2.3 Implementation sample

Let us consider implementing management models of e-learning in teaching discipline «Innovative methods, technologies and monitor the quality of e-learning», one of the four disciplines of professional training within the specialization «Management of e-learning».

Approximate basis for action to implement blended learning in the study of this discipline are presented in the form of e-learning courses developed on platform LMS Moodle. In a blended education context, Learning Management Systems (LMS) can be thought to integrate collaborative and interactive learning activities; this, however, requires a strong institutional and sociocultural commitment from all stakeholders.

Training material of discipline has a modular structure. The first module «Education policy in the field of ICT educational institution» is an overview of innovative educational technologies, trends and education policy of educational institution. As a result of the study module students make ICT development plan of the institution or its structural unit, present it to the group. This task belongs to the competence, combining educational, scientific activities of students as well as social and professional, as the analysis of the current state of the institution in terms of ICT use and development of the educational environment and proposals for the development of ICT policy is one of the tasks of teaching practice. In studying the second module «Educational technology and science communication» students with means of scientific communication explore issues of effective use of innovative educational technologies. The result of work is (group work) webinars on the use of educational technology in schools of various types. As part of the training webinars are held for students of educational groups, but prepared materials can be used for the training of teachers, particularly during the practical training. The third module «Fundamentals of educational design» includes tasks aimed at research on the design of the educational process with the use of innovative teaching and ICT technologies, and educational aspects of e-learning and the creation of information support. As a result, students develop study module design of particular topic (selected in accordance with the subject area in which the student specializes) by technology of blended learning. Thus students are offered freedom on the choice of methods, forms and tools (ICT tools) to implement their own project. Assessment of quality e-learning, and the development of criteria and evaluation of individual projects developed by students in the 3rd learning module, is in the process of work on the module «Monitoring and evaluation of the quality of e-learning». The results of learning and self-study students represent educational and scientific seminar (module control). As a result of mastering the module «Informal education and training» students are building a roadmap own self, developing materials for teachers on issues of e-learning. Expert assessment development of students is in the process of educational practice. Students also have the opportunity to take professional certification program Teaching with Technology, because the university has an authorized certification center CERTIPORT.

2.4 Learning outcomes

Assessment of students' cognitive and communication skills in the process of mastering the discipline according to the developed model (Fig. 1) occurred by solving competency assignments, individual (e.g. creation of e-textbook for students) and collective (e.g. mapping of knowledge on certain topics) projects. Monitoring and evaluation components of the ICT competence held by online testing, and professional and specific by asking students performed at the beginning and at the end of the discipline.

The results of testing the level of ICT competence of students has increased by an average of 25 %. Entry level of professional and specific competences (self-evaluation of students) coincides with the control evaluation of teachers (conducted during the exam) and shows the quality training of masters (Fig. 2).

According to students that progress use technology of blended learning (80 %), most students prefer not deferred in time practical implementation (65 %) - the result of the use of inverted model of education; teachers opportunities to receive advice, including online (78 %); project work in small groups (70 %); peer to peer (70 %) and expert assessment (65 %). In their comments, the students expressed a high level of readiness to use ICT in their own careers (83 %).

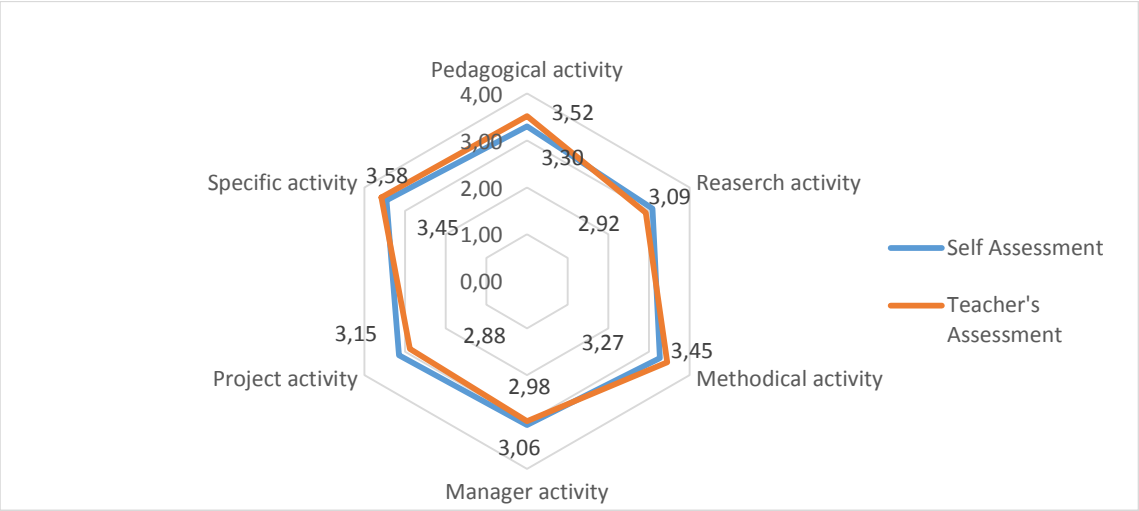

Fig. 2. Level of students specific professional competencies (self-evaluation and evaluation of teachers, average values)
Source: own

CONCLUSION

Analysis of the survey results shows the positive effect of a systematic approach to e-learning managers training by Blended Learning technology:
– likelihood of personal activity of students increases when students are involved to empirical activities based on their professional experience (work or practice in schools);
– combination of full-time and distance learning provides learning opportunities for each student according to the characteristics and pace of mastering educational material; available Internet connection is the only obstacle to obtaining relevant data;
– combination of formal and informal education provides personalized training when used inverted model of learning;
– competence performance of individual tasks and collective projects contributes not only professional competence but also the skills of the 21st century.

The introduction of e-learning as a subject of study and learning tool masters in conditions as close as possible to the profession leads to the fact that throughout the study, students are developing practical confirmation obtained educational results and system reflection of their own activities and have the opportunity to obtain expert assessment or consultation, cooperation and communication. Defining features of preparation of masters – the future managers of e-learning for different professions is the subject of further research.

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Acknowledgement
The research leading to these results has received, within the framework of the IRNet project, funding from the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme FP7/2007-2013/ under REA grant agreement No: PIRSES-GA-2013-612536 and statutory research.

ELECTRONIC COMMUNICATION IN EDUCATION: A STUDY OF NEW OPPORTUNITIES

Tatiana Noskova, Tatiana Pavlova and Olga Yakovleva
Herzen State Pedagogical University of Russia,
Nab. R. Moiki 48, 191186 St. Petersburg, Russia
noskovatn@gmail.com, pavtatbor@gmail.com, o.yakovleva.home@gmail.com

Abstract: *Electronic communication has the features of flexibility, scalability, multiple channels, and algorithmization of interaction. According to the student-centered learning strategies, active communication actions in the electronic environment should develop around the learner: the learner chooses the preferred channels and modes of communication, interaction partners, and communication formats "one-to-one", "one-to-many", "many-to many" with the advantages of joint network activities in collaboration with external social partners. Among the educational and developing effects of communication in the digital environment are the acquisition of communicative competences and self-education, particularly relevant to the lifelong learning strategies. The article gives examples of experimental research in training future teachers to implement interactions in the electronic environment using ICT tools - blogs and wikis. The use of blogs includes variability purposes, e.g., discussion, individual reflection, self-presentation, and different organizational forms of work (individual or in-group). The particular idea of a wiki use is organizing collaboration of students from different courses (bachelors and masters) in order to enhance their experience of joint activities in the electronic environment. These new competences of electronic communications are highly demanded in terms of continuing education paradigm and evolving digital economy.*

Keywords: electronic communication, communicative competence, wiki, blog, e-learning, ICT tools.

INTRODUCTION

Within the evolving knowledge society, new goals of human development become obvious in educational activities. These goals imply education together with the lifelong learning strategy as the most important life values. The upgrowth of such values and personal qualities in a learner needs a teachers' attention both in the classroom activities and in the electronic part of the learning environment. Self-guided students' activities facilitation in the electronic environment requires new teachers' competences, and these competences are connected with communication and interaction. For example, to "see" through electronic discourses how a learner analyses, plans, manages and regulates own activity, what goals and objectives prevail in learning; to track and guide a learner's activity, i.e. to motivate for higher achievements, for social collaboration or scientific activities, for creativity development and self-realization [1]. Electronic media not merely opens the access to unlimited resources in the native and foreign languages, but involves in communication, interaction and collaboration on the base of these resources [2].

1. EXPANDING COMMUNICATION CAPABILITIES IN E-LEARNING ENVIRONMENT

Electronic communication has the features of flexibility, scalability, multiple channels, and algorithmization of communication [3]. What exactly these features are manifested in and what effects they promote?

Firstly, in e-environment a communication event (discourse) can be multivariate, including synchronous and asynchronous interactions in different types of speech (oral, written, audiovisual, and multimedia) with the use of various Internet services and technologies in extended spatial and temporal framework [4]. Multivariance of unfolding discourses optimizes conditions for participants' inclusion and allows solving certain classes of educational objectives based on interactions and communication. Secondly, a network communication distinctive feature is the algorithmization of communication actions by the technical services used. Technical equipment and technology set certain algorithms of discourses, communication protocols, and information exchange. It means that technical services define communication "rules" that determine the sequence of actions necessary for the implementation of web-based information exchange.

The network communication algorithms include three interrelated aspects. The first aspect is connected with software and computer facilities that set specifics of network activity - synchronous or asynchronous communication, the allowable amount of transmitted information, etc. The second aspect is related to communication schemes (or combinations) of interactions between participants - one-to-one, one-to-many, many-to-many. The third aspect is associated with the linguistic features of communication acts, because technologies convert speech codes to certain types - written, spoken, and audio-visual form, including all possible combinations with the addition of multimedia components [5].

It should be noted that automation of the communication process could have both positive and negative sides. For example, if a person with a poor communicative culture mainly uses formalized and simplified mediated communication techniques, this could lead to a reduction of language skills development. Therefore, e-learning environment should contain a variety of training for the development of communicative competence: diverse communication tasks, promoting active use of different types of speech.

ICT-tools define certain "rules" of network activities, for example, the format of expression or its structure. However, the content of the message is entirely created by a student and reflects mental activities and broad system of meanings. Not only the acquired knowledge can be assessed but also a system of values and personal attitudes. This is very important for the educational purposes, because it becomes possible to exercise a wide social context of the knowledge use and to allow solving competence-based problems, so important for acquiring practical experience. This is particularly important for the humanities, which include non-rigid content with a large part of interpretations, meanings, and assigned values.

2. EXPERIMENTAL RESEARCH IN TRAINING FUTURE TEACHERS TO IMPLEMENT INTERACTIONS IN THE ELECTRONIC ENVIRONMENT WITH THE USE OF ICT TOOLS

In the contemporary electronic environment, the core changes are taking place in the education specialists' readiness to professional problem solving. Communicative competence of a teacher now necessarily includes skills and abilities to organize and facilitate electronic educational interactions. Properly organized and managed electronic educational interactions expand learning opportunities.

We can determine a number of requests for training high school students in the field of pedagogy. External request (for the professional training of future teachers from the society) is a contradiction between the needs for the expanded information society skills, especially electronic communication, and the traditional content of teachers training. We can stress that XXI century specialists need not only be able to navigate in a variety of electronic tools and information capabilities, but also actively participate in online professional communities, i.e. to carry out network communications solutions for professional tasks [6]. This demand is being implemented through competence based learning [7].

Internal request to teacher training is defined as a conflict between learners' abilities to communicate by the means of modern technologies in the network environment for everyday problem solution and the readiness for professional communication, implemented with the help of information and communication technologies. Students spend a significant amount of time on the Internet and actively use the existing network communication technologies for personal objectives [8]. At the same time, students do not realize that in the network space there are unfolding new professional tasks related to teachers' abilities of "seeing" students in the electronic environment and interact with the other participants of the educational process. Students not sufficiently understand network communication capabilities as a part of their future professional activities.

Communicative competence is one of the key competences in teaching. In general, communicative competence includes perception, interaction and communication [9]. These aspects are expanding in today's digital media and comprise language knowledge, ways of interacting with others (face-to-face and in a remote mode), collaboration and group work skills, knowledge of different social roles in networking, conflict resolving, etc. For example, Chawinga claims that "blogs are catalysts for the much hyped learner-centered approach to teaching because using these technologies, it emerged that students shared and discussed course materials, posted their course reflections and interacted amongst themselves" [10]. Heimbuch and Sven prove that wiki provides wide opportunities not just for merely students' cooperation, but also for emerging discussions based on possible occurring content controversies [11]. In addition, the prospective of wiki is related to MOOCs [12].

According to competence-based learning, the means of competence development is a system of tasks, which to a certain extent are modeling the future professional tasks. Thus, we suppose that students need an expanded range of conditions for solving professional problems in an electronic environment. In this case, such ICT tools as blogs and wikis can be beneficial.

The experimental work of developing students' communicative competence with the use of blogs and wiki is being carried out in Herzen State Pedagogical University of Russia, Saint-Petersburg. The pilot research started in September 2017 and involved 100 students

(80 bachelors, 20 masters) within several learning courses: “Information Technology”, “Information culture” for bachelors, and a master course “Telecommunication educational technologies”.

2.1 The use of blogs for the communicative competence development

The main purpose of the use of blogs in the study was the organization of students’ mediated communication. Consequently, blog was the communication tool. During the experimental work bachelors worked on the blog, created by the teacher, and masters were to design their own blogs as tools for solving professional problems. Depending on the set of pedagogical purposes blog could be used as a discussion blog, student’s portfolio (collection of assignments), and a collection of professional resources.

Discussion blog suggested the problematic issues in the framework of the course content, and was used for organizing and supporting discussions. At the same time, all students had the right to publish posts with their problematic issues under the theme, and, therefore, each of the students could try himself in the role of a moderator of the discussion, trying to interest and involve other in the debates on the proposed theme.

While using a blog as a personal collection of works (portfolio), students had an opportunity not only to put all the works in an electronic form on the same resource, but also to get comments on them from peers who also had access to the resource. The main purposes of a student's portfolio were to demonstrate works on the project, together with the reflection and self-evaluation. The teacher had the opportunity to study the works of students placed in chronological order, so this is the way to monitor individual progress of the student.

Depending on the blog’s objectives and its content, we can define the basic organizational form of work with the particular types of blogs. This can be either a group or individual activity of students. Speaking about the educational process organization forms, we can choose module training (blog acts as a means of organizing students’ group work), virtually distributed learning (blog serves as a means of communication of classroom and extracurricular activities) and distance learning (blog allows to organize independent individual learning, facilitated by the teacher).

2.2 Using wiki for the development of communicative competence

The main purpose of using wiki in the experiment was the support of students’ collaboration during their project implementation activity. The main objective of the collaborate work in wiki was creating a joint article as the quintessence of the research project in the framework of the course (for example, “The specificity of virtual communication”, “Socialization of the person in the information society”, “Multimedia technologies in school”, “Information security and protection information”, etc.)

Collaboration is one of the components of communicative competence. In the course of the project students had to plan their actions, and determine the optimal sequence. Wiki environment allows students to act not only as learners but also as teachers, researchers, implementing the principle of mutual learning – the main characteristic of wiki. Wiki creates the conditions for a transition from a formalized sequence of solutions to the independent creative students’ activities.

Students' work with wiki included the following steps:

- Introduction of the basic steps of a wiki environment use and its collaborative methodology,
- Students networking in the wiki environment (implementation of project in the particular course framework),
- Reflection on the wiki activities,
- Peer assessment,
- Articles improvements on the basis of peer assessment recommendations,
- Assessment by the teacher.

At the initial stage, students could work in pairs or groups, interacting both face-to-face and in wiki. After completion of the articles students were suggested to peer assess the works done, give comments and specific recommendations on each other's articles. Based on peer assessment, some adjustments were made.

The next stage of the experiment was editing articles by master degree students. Possessing a more extensive educational experience, they were asked to make adjustments in the structure and the content of articles. Thus, each wiki article passed two editing stages, after which they were again presented to their initial authors, who were given the right to make final adjustments. The sequence of work with wiki is presented in the Figure 1.

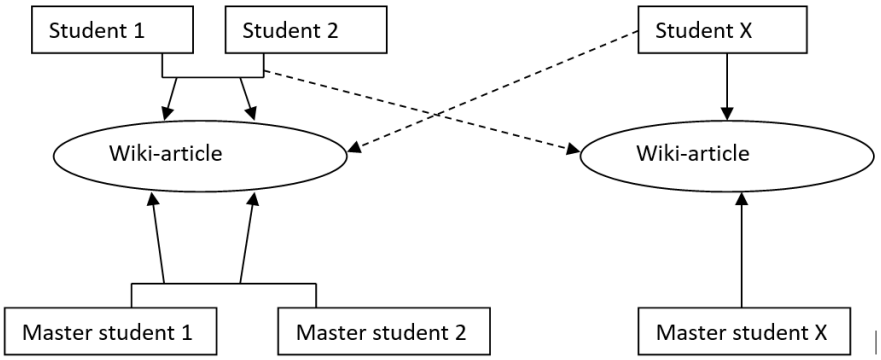

Fig. 1. Sequence of work with wiki articles
Source: own

Students' networking and teacher-supported interactions based on wiki technology allow achieving the following objectives:

- Implementing an effective interaction,
- Providing access to information resources of all participants in the educational process,
- Organizing effective management and facilitation,
- Promoting students' online learning communities with the intense knowledge exchange, high motivation, mutual support, experience exchange, and self-organization.

In addition, in the context of joint wiki activities, we witness the changes of teachers' roles. The role of a teacher as a person with a broad social and scientific experience is motivating and facilitating students to an appropriate methodological direction, assessing and promoting their activities and personal contribution to the general discussion of the problem.

2.3 Research results

Here are some of the experiment results. The elaboration of the criteria for evaluating students' communicative competence development is based on three main components of communicative competence that are noted by most of the authors - motivational, cognitive-operational and reflexive [13, 14]. In the e-environment context, the motivational component includes the willingness to use communication, based on ICT, in teaching activity. The reflexive component is manifested in the attitude to communication, including ICT-mediated, as a part of teaching activities. The core of the cognitive-operational component forms the experience of solving educational and professional problems in the e-environment. Thus, we can assume that the effectiveness of student's communicative competence development depends on joint enhancement of these three components: students are willing to use ICT-based communication, perceive it as the important part of their professional activities and have enough training in solving professional problems in the e-environmant. While evaluating the effectiveness of students' communicative competence development, we carried out both the analysis of students' assignments by the teachers and students' self-assessment. For this purpose, we developed a questionnaire for students' self-assessment and a questionnaire for teachers, evaluating learners' activities. The 30-point scale allowed introducing the three levels of students' communicative competence development: low level (0-10 points); medium level (11-20 points); high level (21-30 points). Among the main objectives of the pilot research was testing the questionnaire and revealing the first evidence of the experimental work efficiency.

The figures 2-4 below show the ratio between the level of communicative competence in the starting and the final stages of the work.

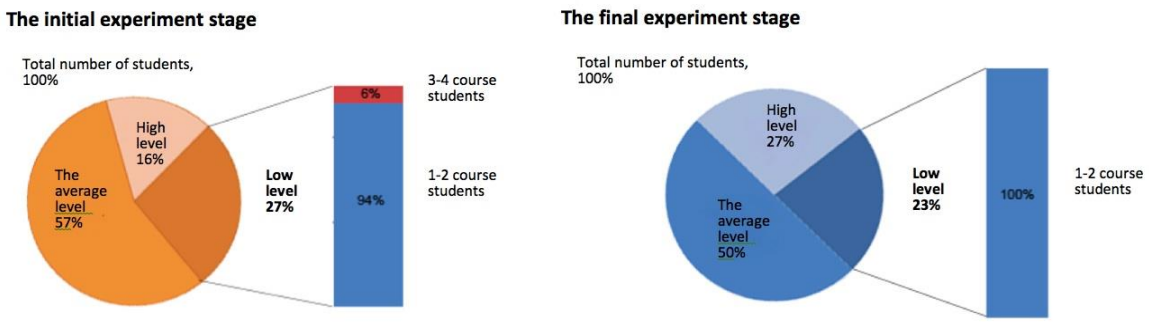

Fig. 1. Distribution of students with low level of communicative competence on the starting and final stages of the experiment
Source: own

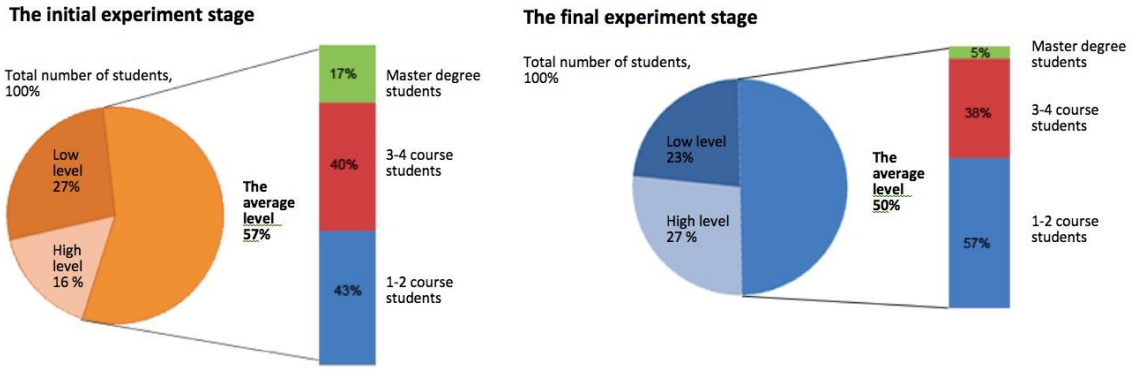

Fig. 2. Distribution of students with middle level of communicative competence on the starting and final stages of the experiment
Source: own

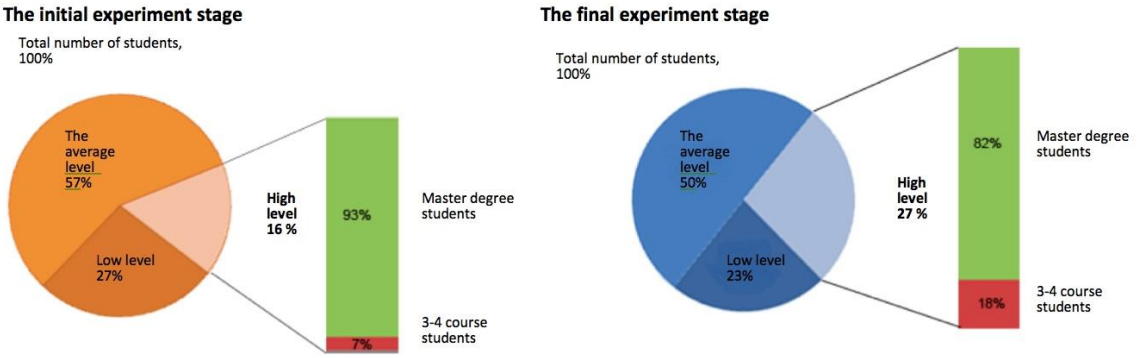

Fig. 3. Distribution of students with high level of communicative competence on the starting and final stages of the experiment
Source: own

The pilot research depicted in this paper aimed at testing the approach to using blogs and wikis in the described above ways. We can witness some evidence of students' competence improvement. However, the first received data can be considered not sufficient for making overall conclusions. Consequently, the research prospective presupposes the increase in the number of participants and more detailed qualitative and quantitative data analysis, including its statistical processing. In addition, future research directions could involve the comparison of bachelor and master students dynamics in competence development.

Summing up, we see that blogs and wiki expand the range of conditions for communicative competence development in the electronic environment, because they provide more opportunities for practical experience in problem-solving. Moreover, these ICT tools facilitate the networking skills shaping while involving students in the network interaction on educational and professional issues with all e-environment participants – teachers and other students.

CONCLUSION

According to the student-centered educational strategies, active communication actions in the electronic environment should revolve around the learner: the learner chooses the preferred

channels and modes of communication, interaction partners, and communication formats (one-to-one, one-to-many, and many-to-many) with the advantages of joint network activities in collaboration with external social partners.

Communicative competence has become one of the most urgent and important competencies in terms of the expanded information and communication environment. Communicative competence is interpreted within the wide range of the 21st century competencies. In particular, in order to carry out a successful communication and interaction it is not only necessary to possess the mother tongue, including oral and written speech, but also to know foreign languages, as well as to understand the international context, be aware of socio-cultural phenomena, possess translitarecy skills, etc.

The use of ICT tools supporting collaboration, especially blogs and wikis, allows creating an extended range of professional tasks for students' solution in an electronic environment. These ICT tools allow developing students' communicative competence, as well as broaden students' outlook, and expand professional skills that can be required in international teams, remote work and collaboration, networking, and motivation management.

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Acknowledgement
The research leading to these results has received, within the framework of the IRNet project, funding from the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme FP7/2007-2013/ under REA grant agreement No: PIRSES-GA-2013-612536.

BLENDED LEARNING IN MATHEMATICS: TEACHERS' EXPERIENCE AND STUDENTS' OPINIONS

Dana Országhová and Radomíra Hornyák Gregáňová
Slovak University of Agriculture in Nitra
Tr. A. Hlinku 2, 949 76 Nitra, Slovak Republic, dana.orszaghova@uniag.sk

Abstract: *The main objective of this paper is the analysis of the important factors and questions in the context of blended learning and e-learning in mathematics. The term of blended learning appeared for the first time in the 1960s and its development occurred in the connection with the start of the implementation of the information technology in the education in the late 1990s. The main principle of the blended learning is that it combines online digital media with traditional classroom methods. One of the biggest advantages of the blended learning is the possibility for the active individual self-learning of students, especially in the part-time study forms with a small hour range. Now several models of blended learning are in usage and they can be combined together as well. At the universities the blended learning is implemented in the teaching of mathematical subjects as a part of e-learning to improve the quality and the efficiency of the education. In the analysis we will concentrate on the students' opinions and results of conducted questionnaire survey among the students in the first year of the bachelor degree at the Faculty of Economics and Management of the Slovak University of Agriculture in Nitra.*

Keywords: *mathematics, blended learning, digital literacy, LMS Moodle, graphic and visual tools, questionnaire survey.*

INTRODUCTION

The application of computers and information technology in the process of education belongs to activating methods, especially in the individual study form. In the education at universities we often meet with using of various forms of information and communication technology (ICT), specifically blended learning. Blended learning is a combined form of education, where the face-to-face teaching is completed by e-learning [1]. E-learning has become one of the most popular and progressive forms of education and easiest way for accessing a huge amount of information [9]. An ideal form is blended learning, in which the theoretical part is explained in face-to-face instruction and individual work continues via distance learning [4].

1. BLENDED LEARNING AND E-LEARNING IN UNIVERSITY EDUCATION

One of the other possibilities, respectively form of learning is called combined (integrated) form of teaching and learning, which combines the classical form of teaching (face-to-face) and a form of online education in which teachers give feedback to their students both in the classroom as well as in the e-learning portal. This form of teaching was known as "blended learning". Blended learning is via methodological, media-didactic and media-pedagogic aspects not only mediation of information, but also knowledge and we talk about integrated form processing and knowledge-sharing [5]. Blended learning systems combine face-to-face instruction with computer-mediated instruction [3]. As it is known, learning can be referred to as the blended if about 50 per cent of the learning interaction is mediated by ICT [12].

Blended learning is connecting the traditional way of education with the multimedia assisted learning [13]. Blended learning is associated with digital competence; it involves the confident and critical use of technology in the information society. It is based on the basic skills in ICT – the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate in different social networks [8]. Communication through the Internet gains more importance in case of permanent changes, dynamism of environment, globalisation and development and greater use of technologies [2].

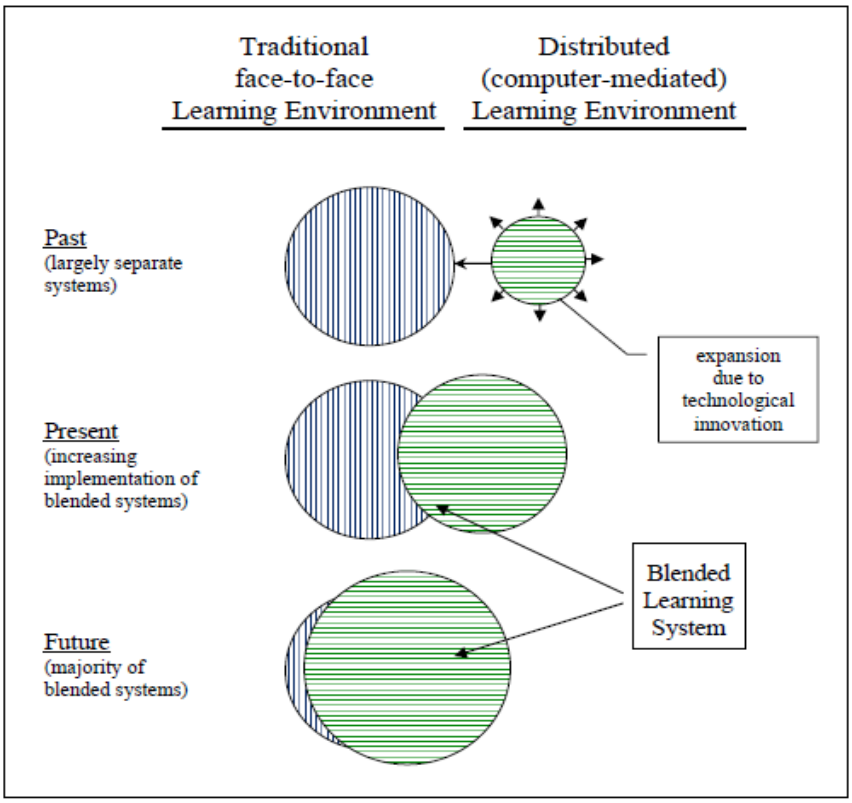

Fig. 1. Blended learning
Source: Bonk and Graham, 2012 [3]

The introduction of IT into the educational process at universities also means a change in the system of student´s education who is forced to work independently, search for the necessary information, to make decisions and choose their own practices, to discover new relevant information and relationships more easily. The education with using new technologies is very flexible and widely available at any location with access [7]. The module e-learning is also designed for students at all levels of study, who can find additional sources for studies, due to the fact that many courses or objects are accessible. In addition, they can utilize distance learning [14]. Students have the task to synthesize the data and information from various sources (primary or secondary research) with the aim to develop a strategic view of the solved problem [10]. The positive effects of learners interacting in electronic educational courses are widely used in various study areas. Solving of applied tasks is necessary for the development of expert skills, for example: in economics, management, accounting and other [6].

The process of creation of interactive multimedia courses and their distribution to users, as well as management of teaching on the basis of these courses is referred to collectively as e-learning, whether in the form on-line or off-line learning. E-learning courses are the current possibilities of applying modern teaching methods in higher education. E-learning courses as

a practical application of new educational approaches and methods provide opportunities for the application of the specific requirements of individual subjects [11].

The mathematical education in universities has been for many years influenced by the implementation of IT into the educational process. Effective possibilities of using information technology and its tools in the education of mathematics and in the individual study of mathematics are following:

- Web sites as a tool of education and visualization of tasks.
- Electronic educational courses in the environment LMS Moodle [7].

LMS Moodle is one of tools which can be used to realize the blended learning in math. The most common used tools in the creation of the electronic courses for mathematics are:

- Resources: File, Folder, Page and URL,
- Activities: Assignment, Questionnaire, Quiz and Upload a single file.

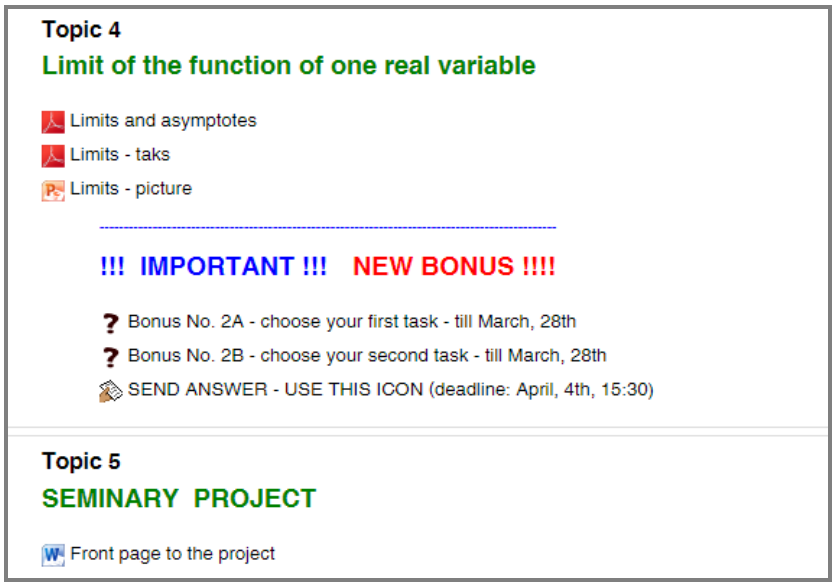

Fig. 2. Illustrative sample from the LMS Moodle course "Mathematics"
Source: own

2. RESEARCH DATA

We were interested in the opinions of students what kind of electronic tools they often use in the study of mathematics. Specifically, we focused on the use of electronic courses created in LMS Moodle and mathematical resources available at the Internet. The questionnaire survey is one of the most commonly used methods in research to collect data for analysis. It is used in the social sciences for mass and rapid identification of facts, opinions, attitudes, preferences, values, motives, needs, interests and others. The presented survey was conducted during the academic year 2016/2017 and the statistical sample included 85 students. These respondents were students of the 1st study year at the bachelor degree at the Faculty of Economics and Management of the Slovak University of Agriculture in Nitra.

3. RESULTS AND DISCUSSION

In this part we present the results of analysis of students' opinions acquired via the questionnaire survey about the use of selected tools that belong to the blended learning. The results show that new method of study with special IT tools is not used automatically by all students. Teachers' experience proves the following comments to the results. In the Tab. 1 there are collected responses to the question No. 1), question No. 3) and question No. 4).

Question No. 1: The type of the completed high school.
The 1st question of the questionnaire was associated with the type of completed secondary school. In the Tab.1 we can see the structure of attended and completed secondary schools according to types. The majority of students finished the business academy (46.55 %); the second type is the comprehensive school (29.31 %). The minority of students finished the secondary grammar school (24.14 %).

Question No. 2: School-leaving examination in Mathematics: Yes, No.
The responses to the 2nd question prove the relationship to the mathematics and expected level of mathematics knowledge. In our sample the major group is created by students without school-leaving examination in Mathematics (78.64 %) and minority of students passed this examination in math (21.36 %). These students are also more active in lectures and seminars.

Type of secondary school [1)]	**LMS Moodle** [3)]	**Apps in mobile phone** [4)]
grammar school	once in week	calculator
24.14 %	25.86 %	53.45 %
business academy	once in month	graphic and visual tools
46.55 %	63.79 %	5.17 %
comprehensive school	no use	no use
29.31 %	10.35 %	41.38 %

Tab. 1. Responses of students expressed in percentage
Source: own

Question No. 3: The frequency of using LMS Moodle tools:
a) every week b) once a month c) no use.
The results show that about 90 % of students use tools of LMS Moodle; the frequency once in week 25.86 % of students and once in month 63.79 % of students. The preferred "month" frequency is connected with three important events during the term: first one is the first control test, then the seminary project and, finally, the exam test.

Question No. 4: Usage of mathematical/computational and graphical applications in a mobile: a) I use (write the title), b) no use.
The resuls in the table prove the following ratio of responses: 58.62 % of students use some kind of math application in the mobile phone and 41.38 % of students do not use such applications. Students of economic and management study programs apply calculators in mobile phones for calculations very often; not only in mathematics but also in specialized subjects as economics, accounting, finance, and so on. Actual applications in mobile phones are based on better operation system, bigger memory space and these could be reasons for problems with usage of computational tools in mobile phones by students.

Question No. 5: Write your favourite websites and communication tools.
In the Fig. 3 there are collected the answers of students to this question. The first part of answers belongs to the communication tools and web pages; together 57 (= 24 + 17 + 16) students from 85. We can see that the most popular tools are social nets; here the students interchange the information about lessons, news from school days and necessary agenda, for example: seminary projects, bachelor thesis, web pages of university or faculty, Erasmus stays and so on. In the Fig. 3 it is also presented the second part of answers which is connected with web pages with mathematics topics, free graphic and math programs for special math calculations and tasks solutions; together 43 (= 12 + 10 + 8 + 8 + 5) students from 85. It follows from results that students do not use frequently math applications, special programs and web sites with math topics. The answers about mathematics tools and usage are in minority. Therefore, the important actual task for mathematics teachers is to motivate students to find and to apply these useful tools; moreover, to include in the teaching content of the lectures and seminars more activities of such kind.

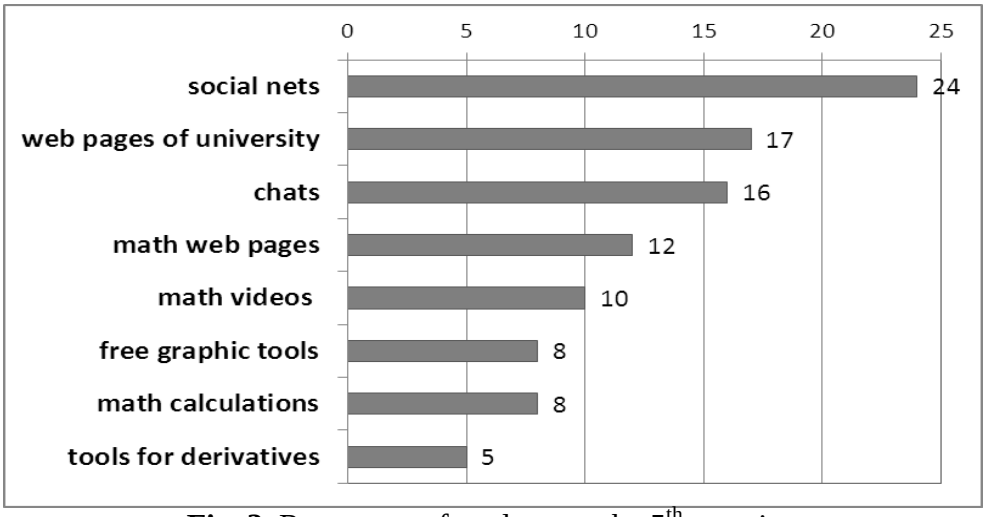

Fig. 3. Responses of students to the 5th question
Source: own

CONCLUSION

The main aim of this paper was to identify the important factors and questions associated with the blended learning in mathematics. We use selected tools of LMS Moodle as the support in the standard educational process since year 2005. Based on years of experience we consider e-learning and blended learning as an effective mean for the increasing of the quality of the educational process. Big advantage of this method is evident in the part-time courses which are typical with small hour range of contact lessons, having the centre built on the individual study. Learning activities and designing of study courses with applying of existing study web pages shall possess:

- The clarity of mathematics content and steps of detail explaining (program teaching),
- The logical structure of the study texts, tasks and activities,
- The possibility for students to return to the more difficult studied topic,
- The self-control as a feed-back in the form of questions or tasks.

The first study year at a university has the key significance from the aspect of adaptation process of new students. The study methods applying the activities of blended learning could reduce the stress and frustration of students caused by the lack of practical skills as well as the

gaps in mathematics knowledge from the secondary schools. This methodology of education could increase the activity of students in math education and to improve their exam results.

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Acknowledgement
The work presented in this paper has been supported by the project No. 038SPU-4/2016: *Using of new technologies and interdisciplinary associations in consumer studies*.

RISKS EVALUATION IN PREPARATION OF CRISIS MANAGEMENT EXERCISE

Alena Oulehlová[1], Hana Malachová[1] and David Řezáč[2]
[1]University of Defence
Kounicova 65, 662 10 Brno, Czech Republic
alena.oulehlova@unob.cz, hana.malachova@unob.cz
[2]VR Group, a.s.
Poděbradova 287/111, 612 00 Brno-Ponava, Czech Republic, david.rezac@vrg.cz

Abstract: *Part of the preparation of a staff crisis management exercise should be implementation of risk management in order to achieve the main goal of the exercise. Planning team does not usually include such requirement into designing and preparing the exercise or uses risk management methods to a minimal extent. On the basis of a general process in the risk management and use of qualitative methods (brainstorming, "What if method", HAZOP), threatened assets and sources of hazards have been identified and the risks have been estimated for the purpose of the preparatory phase of the SIMEX 2016 exercise as well as for the forthcoming exercise in 2017. Particular emphasis in the risk analysis was put on the risks associated with the use of the proposed simulator designed for the preparation, implementation and evaluation of the exercise. Identified risks fall within the category of sector risks – economic, security, technical, personnel and information ones. The presented article implies that application of risk management into the process of preparation of crisis management exercise tends to enhance the level of reaching the goals of the exercise and increase the ability of authorities to be able to better and more timely respond to possible shortcomings.*

Key words: risk management, exercise, crisis management, simulator.

INTRODUCTION

Since the Yokohama Strategy and Plan of Action for a Safer World [1] where the principles of disaster reduction strategy were defined, the responsibility of the country to protect its population, infrastructure and other assets from disasters has been defined. As a priority in terms of disaster reduction, prevention, preparedness and risk assessment for the adoption of adequate and successful policies and measurements for reducing disasters have also been considered. In the frame of crisis preparedness, a key role is played by crisis management exercises at central, local and international levels. Exercise of the risk management components represents an essential tool for preparing for both emergencies and crises [2]. For this purpose the authorities bodies implement regular coordinated exercises of different length, content and organizational difficulty. Across the different types of exercise, they all have a common goal – to improve readiness, verify crisis, emergency, response plans and coordination mechanisms and based on the identified results of the exercise implement recommendations for their improvement.

Even during designing and preparing the exercise, negligence or omission of some activities or emergence of shortcomings which subsequently adversely affect the course and outcome of the exercise can appear. Application of risk assessment in the phase of designing and preparing the exercise can contribute to increasing the level of fulfilment the exercise goals.

1. THEORETICAL PART

1.1 Exercise organisation

The Homeland Security Exercise and Evaluation Program [3] states 4 partial phases of the exercise that ensure consistent and interoperable approach to the exercise of crisis management. Fig. 1 shows these individual phases. These are [3]:

- Exercise Design and Development – In designing and developing individual exercises, exercise planning team members are identified to schedule planning meetings, identify and develop exercise objectives, design the scenario, create documentation, plan exercise conduct and evaluation, and coordinate logistics. At key points in this process, the exercise planning team engages elected and appointed officials to ensure their intent is captured and that the officials are prepared to support the exercise as necessary.
- Exercise Conduct – After design and development activities are complete, the exercise is ready to occur. Activities essential to conducting individual exercises include preparing for exercise play, managing exercise play, and conducting immediate exercise wrap-up activities.
- Exercise Evaluation – Evaluation is the cornerstone of an exercise and must be considered throughout all phases of the exercise planning cycle, beginning when the exercise planning team meets to establish objectives and initiate exercise design. Effective evaluation assesses performance against exercise objectives, and identifies and documents strengths and areas for improvement relative to core capabilities.
- Improvement Planning – During improvement planning, the corrective actions identified during individual exercises are tracked to completion, ensuring that exercises yield tangible preparedness improvements.

Fig. 1. Cycle of the exercise
Source: [3]

Czech regulations [4] state only three levels of tactical exercises, but in terms of their characteristics they correspond with the above presented approach [3].

1.2 Exercise of the integrated rescue system and crisis management

At the national level, exercises are carried out by the Integrated Rescue System (IRS) and crisis management authorities. IRS exercises are divided into screening and tactical. They form part of a regular specialised training. IRS screening exercises serve for reviewing the readiness and operability of the Fire Rescue Service Units (FRS), for preparing the IRS components to carry out rescue and liquidation work, for testing emergency plans, and for monitoring cooperation between FRS units and other IRS components. The tested IRS components should not know about the exercise in advance [5]. Tactical exercises of IRS components are intended to test the preparedness of IRS components and bodies involved in the implementation and coordination of rescue and liquidation work during an emergency. Tactical IRS exercises are according to the scope of the exercise and the level of coordination of IRS components divided into tactical, operational and strategic levels [5]. Exercises are announced in advance.

Exercise of crisis management represents an essential form of preparation of crisis management for dealing with emergencies during which a state of emergency is declared. It can be divided from several perspectives [4]:

- according to the organization: domestic x international exercises,
  single-stage x multi-stage exercises,
- according to exercising authorities: authorities at the central level x authorities at the regional level,
- according to the content focus: non-military crises situations x military crisis situations.

Documentation which is used for the preparation and implementation of the exercise and which characterizes its whole content forms part of the exercise.

1.3 Risk management

Risk management comprises coordinated activities to direct and control an organization with regard to the risk. Risk management process is a systematic application of management policies, procedures and practices to the activities of communicating, consulting, establishing the context and identifying, analyzing, evaluating, treating, monitoring and reviewing the risks [6]. Knowledge of risks is the basis of crisis and emergency preparedness [2].

Risk assessment represents a key phase of risk management. Risk assessment is a systematic, step-by-step approach to evaluating risk [7]. Risk assessment is an overall process of risk identification, risk analysis and risk evaluation [6]. The process of risk identification involves finding the causes and sources of risk which could have an impact on the assets. For risk assessment either general methods (brainstorming, Delphi, individual notebook and brain writing) or special methods (HAZOP, ETA, FTA, HRA [7, 8], etc.) can serve. In the subsequent risk analysis, determination of impact and frequency of the identified events taking into account the presence or absence of mitigating measures is carried out. Risk is calculated as a combination of impacts, frequency and time. Listing the uncertainties also forms a part of the risk analysis. Risk assessment can be carried out by qualitative, semi-quantitative or quantitative methods. Risk assessment also includes a comparison of the estimated risk levels with the criteria set out during the determination of context in order to determine the significance of the level and type of the risk [9].

Risk monitoring is performed in order to improve risk assessment and for update purposes. Communication about the risk helps to provide, share and gather information and to engage stakeholders in the dialogue.

Relation between the individual phases of risk management is presented in Fig. 2.

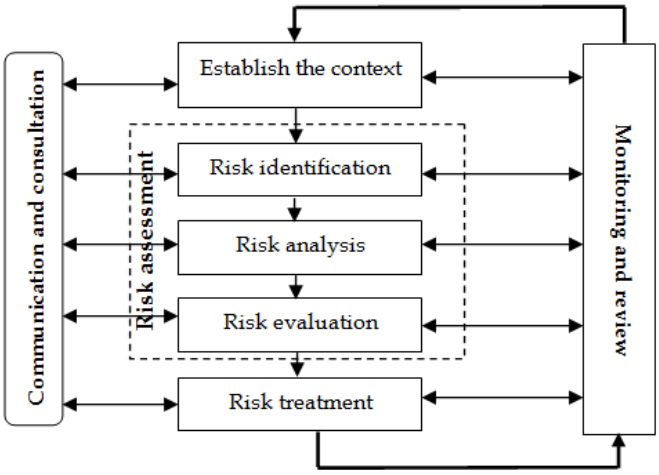

Fig. 2. Phases of the risk management
Source: [9]

2. METHODS USED

Method of brainstorming and What if method [9] were used to identify sources of risk, compile the registry of hazards, monitor frequency of impacts and design and prepare the exercise [10, 11].

Brainstorming and What if methods were implemented during common planning meetings of the members of preparation team of the exercise. What if method was used by planning team to examine unexpected events that might occur. Questions were dealt with in the way, "What will happen if ...". Then the consequences were estimated and measures and recommendations were proposed.

Representative of a regional crisis management was named the head of the brainstorming. Presented questions were not systematized. Brainstorming was carried out as a multiple-round one. The topic of the exercise was discussed, the processes for high-quality solution, implementation and evaluation of the exercise were designed and new thoughts and ideas that would lead to improvement of the entire course of the exercise were raised. The main principle of the brainstorming was elimination of all restrictions and the effort of the head to stimulate creation of new ideas.

Brainstorming was further used to characterize frequency, impacts and level of hazard $R_j(\tau)$ of the exercise proposal. The risk matrix which combines the frequency of risk source activation (very small, small, medium, large and very large) and impact (negligible, marginal, critical and catastrophic) was used to express the level of hazard. The scores for frequency and impact assessment stating the verbal evaluation is presented in Table 1.

Scoring of frequency	Verbal evaluation of activation frequency of the source of risk	Scoring of impact	Verbal evaluation of impacts
1	very small	1	negligible
2	small	2	marginal
3	medium	3	Critical
4	large	4	Catastrophic
5	very large		

Table 1. Importance of scoring of the influence of sources of risks and their impact
Source: own

The expertise of individual members was used for individual characteristics of the level of hazard originated in brainstorming and mutual agreement. The more the risk in the risk matrix moves diagonally right down, the greater the risk, as can be seen from Table 2.

Impact /frequency	1	2	3	4
1	Negligible			
2		Acceptable		
3			Undesirable	
4				Unacceptable
5				

Table 2. General risk matrix and its characteristics
Source: own

Characterization of the risk in relation to the exercise is presented in Table 3.

Level of risk $R_i(\tau)$	Risk characteristic
1, 2	Negligible. Is it possible to continue in the preparation of the exercise? It is not necessary to implement countermeasures.
3, 4, 5, 6	Acceptable. Is it possible to continue in the preparation of the exercise? It is appropriate to make decisions about implementing of countermeasures in coordination with other components of the exercise.
8, 9, 10, 12	Undesirable. Continuing in the preparation of the exercise is limited. To be able to continue in the preparatory phase, it is necessary to implement countermeasures to reduce the risk to an acceptable level.
15, 16, 20	Unacceptable. It is not recommended to continue in the preparation of the exercise.

Table 3. Risk characteristic
Source: own

Hazard & Operability Study (HAZOP) method [12], which was implemented by a team of experts, was used for identifying the sources of risk for the proposed simulator. The HAZOP team listed potential causes and consequences of the deviation as well as existing safeguards protecting against the deviation. When the team determined that inadequate

safeguards existed for a credible deviation, it usually recommended the action to be taken to reduce the risk [13]. HAZOP is a highly structured hazards identification tool. HAZOP is the most widely used methodology used in the word today as a tool for hazard identification. HAZOP can be used at practically any stage. HAZOP can also be used for analysing operating instructions and procedures so that sources of human error can be identified. It is extremely basic in its approach and makes practically no assumptions. HAZOP is very thorough, because you force yourself to painstakingly examine most aspects. Simulates abnormal situations by using guidewords applied to parameters and operations to create deviations [12, 14]. Methodology [14]:

1. Collect applicable documents and drawings.
2. Break facility down into manageable sections.
3. Prepare list of parameters and operations to be examined.
4. Apply guidewords to parameters and Operations.
5. For each node create deviations.
6. List and record causes for each deviation.
7. List and record consequences associated with each cause.
8. List and record safeguards or controls that may prevent cause and/or the consequences.
9. List any future actions or recommendations you think should be implemented.

Risk management has been applied in accordance with the procedures [9], where emphasis was put on the phase of the risk assessment.

3. PRACTICAL PART

The aim of realized risk evaluation was to identify the risks that may arise in the design and preparation phase of the exercise. For the developed simulator only identifying the risk sources was carried out. In accordance with the procedures [9] threatened assets were identified:

1. The exercise documentation (plan of exercise implementation, goal of the exercise, schedule of the exercise and organizational order of the exercise);
2. Documentation of crisis management;
3. Members of the planning team;
4. Exercise participants;
5. Members of the scenarios;
6. Funds;
7. Means of communication;
8. Logistics cover of the exercise;
9. Simulator (hardware, software, person controlling the simulator).

The registry of potential risks for the design and preparation of the exercise together with the identified potentially vulnerable assets 1-8 is presented in Table 4. For the vulnerable assets under number 9, i.e. simulator and its equipment, HAZOP method was applied in Table 5.

Presented registry can be updated/supplemented depending on the type of the exercise. Designing the registry and estimating the risk was based on the general requirements for the preparation of the exercise and experience from the preparation of previous exercises.

Risk	Assets							
	1	2	3	4	5	6	7	8
Undefined exercise topic	+							
Undefined date of the exercise	+							
Change in the date of the exercise	+		+	+	+	+		+
Not defined all stakeholders of the exercise			+	+				
Poorly defined instructions for participants			+	+				
Risk	**Assets**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Outdated set topic of the exercise		+	+					
Narrow plan of scenarios of the exercise			+		+			
Wide plan of scenarios of the exercise			+		+			
No scenarios of the exercise			+		+			
Unearmarked funds for the exercise			+	+		+		
Unrealistic exercise schedule	+		+					
Not provided guidance for the preparation of the participants			+	+				
Narrow provided guidance for the preparation of the participants			+	+				
Widely provided guidance for the preparation of the participants			+	+				
Neglecting the study f the guidelines for exercise preparation				+				
Risk	**Assets**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Absence of participants from instructions for the exercise				+				
No awareness of training environments				+	+			
Uncoordinated preparation for the exercise			+					
Absence of members of the planning team from planning meetings			+					
Not earmarked material resources for the exercise			+	+				+
Not providing information			+				+	
Uncovering the details of the exercise by members of the planning team			+					

Table 4. Registry of potential risks and vulnerable assets

Source: own

Note: 1 Documentation of the exercise, 2 Documentation of the crisis management, 3 Members of the planning team, 4 Participants of the exercise, 5 Members of scenarios, 6 Funding, 7 The means of communication, 8 Logistics support of the exercise.

The results in Table 4 show that the most risks are associated with the members of the planning team, participants of the exercise and exercise documentation.

Developed simulator SIMEX 2016 and its various models were used in the exercise in order to verify its functionality. HAZOP method was used to identify the risks resulting from the use of the developed simulator in the exercise. Table 5 shows an example of HAZOP application.

Guide word	Element	Deviation	Possible causes	Consequences	Security and the required measures
No	Weather model	No weather model	It was not loaded into the simulator, not created	Exercise does not correspond with real conditions	Checking the simulator
As well as	Other intervening units	As well as other intervening units	For the simulation were prepared units that do not interfere in the action	More people involved in the exercise, increased costs, delays in the exercise.	Checking the schedule of the exercise activities
Late	Intervening units	Late intervening units	Instruction to the simulator was given later	Exercise was delayed	Performing tasks in the given deadline
Early	Intervening units	Early intervening units	Instruction to the simulator was given earlier	Exercise was started earlier	Performing tasks in the given deadline
Other than	Communication device of the simulator	Other than communication device of the simulator	Participants used other means of communication than the simulator	Participants have no overview of the development of the exercise.	Keep set communication rules
No	Record of communication	No record of communication	The simulator did not record communication	Impossible feedback control and analysis of the exercise	Continually check the recording

Table 5. Example of HAZOP method application on vulnerable assets – a developed simulator for the needs of the crisis management exercise
Source: own

For each hazard was estimated its risk. The level of risk is determined by multiplying the point value of source of hazard activation frequency and the point value of the impact on the given asset. The results are presented in Table 6.

Serial number	Hazard	Frequency	Impact	Risk
1.	Undefined exercise topic	1	4	4
2.	Undefined date of the exercise	1	4	4
3.	Change in the date of the exercise	3	3	9
4.	Not defined all stakeholders of the exercise	2	3	6
5.	Poorly defined instructions for participants	2	3	6
6.	Outdated set topic of the exercise	2	4	8
7.	Narrow plan of scenarios of the exercise	3	3	9

8.	Wide plan of scenarios of the exercise	3	3	9
9.	No scenarios of the exercise	3	3	9
10.	Unearmarked funds for the exercise	2	3	6
11.	Unrealistic exercise schedule	3	3	9
12.	Not provided guidance for the preparation of the participants	3	3	9
13.	Narrow provided guidance for the preparation of the participants	3	3	9
14.	Widely provided guidance for the preparation of the participants	2	3	6
15.	Neglecting the study f the guidelines for exercise preparation	3	4	12
16.	Absence of participants from instructions for the exercise	3	3	9
17.	No awareness of training environments	3	4	12
18.	Uncoordinated preparation for the exercise	2	4	8
19.	Absence of members of the planning team from planning meetings	2	4	8
20.	Not earmarked material resources for the exercise	2	4	8
21.	Not providing information	3	3	9
22.	Uncovering the details of the exercise by members of the planning team	3	4	12

Table 6. Risk estimation
Source: own

The calculated level of risk falls within the interval ⟨1; 20⟩. Calculated level of risk was plotted in the risk matrix presented in Table 7.

Impact/ frequency	1 Negligible	2 Marginal	3 Critical	4 Unacceptable
1 Very small				R1,R2,
2 Small			R4, R5, R10, R14,	R6, R18, R19, R20
3 Medium			R3, R7, R8, R9, R11, R12, R13, R16, R21	R15, R17, R22
4 Large				
5 Very large				

Table 7. Risk matrix
Source: own
Note: RX indicates the risk and serial number given in Table 6.

Risks matrix in Table 7 shows that the estimated risks are acceptable (yellow area) and undesirable (orange area). The results show that an experienced planning preparation team of the exercise significantly eliminates the frequency of the incidence of adverse events, but not the impacts in relation to the course and outcome of the exercise. The risks with high level of hazard include those in which it is necessary to train the participants of the exercises

and prepare them for the exercise. It is necessary to improve the guidelines for the participants, motivate them more to take active approach to the exercise and minimize the leakage of information from the participants of the exercise planning team.

CONCLUSION

An essential part of crisis preparedness is the implementation of the exercise. Preparation of the exercise especially of crisis management authorities at regional and national levels is highly time-consuming and difficult to organize and requires that members of the planning team to have experience and skills in this field. A modern trend which is gaining ground in tactical cooperative exercise is the use of constructive simulation. Simulators can make preparation of participants of the exercise better and more effective and provide supervising bodies with instant information about the development of the exercise and documentation for the exercise evaluation. Risk assessment process was applied for designing and preparing the exercise. Emphasis was put on the identification of assets, risks, assessment of source of the risk activation and impacts. On this basis, risk which was plotted in the risk matrix was estimated. 22 items of risk, which had acceptable or unacceptable risk level, have been identified. For unacceptable risk, organizational measures were proposed.

Further, using the HAZOP method, risks for the developed simulator for exercises of crisis management have been identified. These risks have been associated especially with the human factor (poor programming of the models, inability to work with the simulator from the part of the participants, non-implementation of the activities during the exercise via the simulator or means of communication) and technical factor (hardware requirements of the simulator, failure of the connection between the participants, low speed Internet connection). Steps to eliminate the identified risks to the developed simulator have been implemented.

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Acknowledgments
Results presented in this article were obtained as a part of the solution of the project by Technology Agency of the Czech Republic with the topic Research and Development of Simulation Instruments for Interoperability Training of Crisis Management Participants and Subjects of Critical Infrastructure (research project No. TA04021582).

ELEMENTARY SOLUTION TO THE JEEP PROBLEM WITH ONE CHIEF AND THREE SUPPORTING VEHICLES

Radovan Potůček
Department of Mathematics and Physics, Faculty of Military Technology,
University of Defence
Kounicova 65, 662 10 Brno, Czech Republic, radovan.potucek@unob.cz

Abstract: *The jeep problem is a well-known logistics problem. A jeep must cross a desert wider than it can travel on one tank of fuel with the help of optimal arrangement of fuel dumps along the route. The available resources refer, especially, to solutions of two basic variants – the single jeep problem and the convoy of jeeps problem. This paper deals with one modification of the jeep problem with* 4 *vehicles and* n *cans of fuel* $(n > 4)$. *Elementary solutions to this modification are derived for small amounts* n *of cans of fuel. General solution using harmonic numbers is also stated. Numerical solutions for some amounts of fuel and units of distance, computed by the computer algebra system Maple, are presented, too.*

Keywords: Jeep problem, harmonic numbers, computer algebra system Maple.

INTRODUCTION AND HISTORY OF THE JEEP PROBLEM

The jeep problem, also called desert crossing problem, was first mentioned in the early 20th century in books [1], [2] containing problems of mathematical recreations. The problem was first solved in 1947 in the paper [3]. Shortly thereafter, the problem was generalized in the paper [4], and solved it by arguing that the single jeep problem is equivalent to a problem of a convoy of jeeps which travel together, some being used to refuel others, with only one jeep required to cross, the others abandoned along the way.

The jeep problem may have application to arctic expeditions in present and to interplanetary travel in future. This problem can have also a practical application in wartime situations. It achieved a great attention during World War II in strategy used in the Pacific theatre by bombing missions. The jeep problem is still a modern and topical problem – see [5] and [6].

This paper is a follow-up to the papers [7], [8], [9] and [10], where elementary solutions to the single jeep problem and to the problem of a convoy of two and three jeeps were derived. Numerical solutions for some amounts of fuel were computed by using the computer algebra system Maple and its basic programming language and were recorded in two tables.

1. FORMULATION AND NOTATION OF THE JEEP PROBLEM

The original jeep problem is formulated as follows. Given a jeep that can carry one tank load (one unit) of fuel and can travel one distance unit per tank load. The jeep is required to cross a desert wider than it can travel on one tank of fuel. To do so, it may make depots of fuel in the desert. We assume that in the beginning of the jeep's mission there are n tanks (cans, units) of fuel at the border of the desert at a fixed base and that the jeep makes n trips to maximize the distance it can travel. Further, we will study the case of four jeeps – three supporting jeeps and the chief jeep, which is supposed to reach the greatest distance.

We will use this notation:
n – the number of cans, i.e. units of fuel, which four jeeps have available for their mission, whereas we assume that the volume of a can is equal to the volume of the jeep's fuel tank,
p – the number of fuel dumps established at various points along the way for temporary storage of fuel,
B – the base – the starting point, where n units of fuel are saved and where the supporting jeeps must return at the end of their trips, except their last trip, when all four jeeps travel as a convoy as far as they can before running out the fuel,
T – the target point – the farthest point, which the chief jeep can reach by support of three other jeeps and by successive using n units of fuel on its final trip ending its mission,
B_i – the fuel dumps established at various points along the way for temporary storage of fuel $(i = 1,2, \dots, p)$; at the fuel dump B_{p-2} the first supporting jeep remains standing and far, towards the fuel dump B_{p-1}, continue two supporting jeeps and the chief jeep; at the fuel dump B_{p-1} the second supporting jeep remains standing and towards the last fuel dump B_p continues the third supporting jeep together with the chief jeep; at the fuel dump B_p the third supporting jeep remains standing and towards to the target T continues the chief jeep alone,
d_i – the length of the ith stretch $(i = 1,2, \dots, p+1)$ of the road, i.e. the distance $|B_{i-1}B_i|$ of the fuel dumps B_{i-1} and B_i on the route $B \to B_1 \to B_2 \to \cdots \to B_p \to T$, whereas $d_1 = |BB_1|$; for maximizing the distance the chief jeep can travel, we assume that it will start with a full fuel tank in the last fuel dump B_p, so $d_{p+1} = |B_pT| = 1$,
s_i – the amount of fuel leaved and stored at the ith fuel dump B_i by ith subsequent trip, where $0 < s_i < 1$ $(i = 1,2, \dots, p)$,
$D(4,n)$ – the maximal total distance travelled by four jeeps by using n cans:

$$D(4,n) = \sum_{i=1}^{p+1} d_i = d_1 + d_2 + \cdots + d_p + 1.$$

2. SOLUTIONS TO THE MAIN BASIC VARIANTS OF THE JEEP PROBLEM

A general solution maximizing the distance travelled by the single jeep with n cans of fuel was derived, among others, in the paper [7]. It can be written in the form

$$D(1,n) = \frac{1}{2n-1} + \frac{1}{2n-3} + \cdots + \frac{1}{5} + \frac{1}{3} + 1 = \sum_{i=1}^{n} \frac{1}{2i-1} = H_{2n-1} - \frac{1}{2}H_{n-1}, \qquad (1)$$

where H_n represents the nth partial sum of the harmonic series, i.e. the sum

$$H_n = 1 + \frac{1}{2} + \frac{1}{3} + \cdots + \frac{1}{n}.$$

A general solution to the convoy of jeeps problem was derived, in the paper [8], too. For given n cans of fuel and for n jeeps, each with capacity of 1 can, the maximal distance which the chief jeep can travel is

$$D(n,n) = \frac{1}{n} + \frac{1}{n-1} + \cdots + \frac{1}{3} + \frac{1}{2} + 1 = \sum_{i=1}^{n} \frac{1}{i} = H_n. \qquad (2)$$

Let us remark, that in the paper [9] a general solution to the jeep problem with two vehicles was derived. The maximal distance which can two jeeps travel with $n \geq 2$ cans of fuel is

$$D(2,n) = \frac{1}{2(n-1)} + \frac{1}{2(n-2)} + \cdots + \frac{1}{4} + \frac{1}{2} + 1 = \frac{1}{2}\sum_{i=1}^{n-1} \frac{1}{i} + 1 = \frac{1}{2}H_{n-1} + 1. \qquad (3)$$

In the paper [10] a general solution to the jeep problem with one chief and two supporting vehicles was derived. The maximal distance for which can this group of jeeps travel with $n \geq 3$ cans of fuel is

$$D(3,n) = \frac{1}{2(n-1)-1} + \cdots + \frac{1}{3} + \frac{1}{2} + 1 = \frac{1}{2} + \sum_{i=1}^{n-1} \frac{1}{2i-1} = H_{2n-3} + \frac{1}{2}(1 - H_{n-2}). \quad (4)$$

Because by mathematical induction it can be for $n > 3$ proved the inequalities

$$H_{2n-3} + \frac{1 - H_{n-2}}{2} = \frac{1}{2(n-1)-1} + \cdots + \frac{1}{3} + \frac{1}{2} + 1 < \frac{1}{n} + \frac{1}{n-1} + \cdots + \frac{1}{3} + \frac{1}{2} + 1 = H_n$$

and

$$\frac{H_{n-1}}{2} + 1 = \frac{1}{2(n-1)} + \cdots + \frac{1}{2} + 1 < \frac{1}{2(n-1)-1} + \cdots + \frac{1}{3} + \frac{1}{2} + 1 = H_{2n-3} + \frac{1 - H_{n-2}}{2}$$

and since for $n > 3$ it obviously holds

$$H_{2n-1} - \frac{1}{2}H_{n-1} = \frac{1}{2n-1} + \cdots + \frac{1}{5} + \frac{1}{3} + 1 < \frac{1}{2(n-1)} + \cdots + \frac{1}{4} + \frac{1}{2} + 1 = \frac{H_{n-1}}{2} + 1,$$

then altogether we have

$$H_n > H_{2n-3} + \frac{1}{2}(1 - H_{n-2}) > \frac{1}{2}H_{n-1} + 1 > H_{2n-1} - \frac{1}{2}H_{n-1} \quad \text{for} \quad n > 3,$$

so it holds

$$D(n,n) > D(3,n) > D(2,n) > D(1,n) \quad \text{for} \quad n > 3,$$

thus

$$D(n,n) > D(1,n) \quad \text{for} \quad n \geq 2. \quad (5)$$

3. ELEMENTARY SOLUTION TO THE JEEP PROBLEM WITH ONE CHIEF AND THREE SUPPORTING VEHICLES

Because, as we stated above in (5), for $n \geq 2$ a convoy of n jeeps with n cans of fuel overcomes greater distance than a single jeep with n cans, we will consider and study, for maximizing the distance overcoming by 4 jeeps with n cans, where $n > 4$, the following strategy, illustrated now for $n = 6$ cans and briefly also for $n = 7$ and $n = 10$ cans:

■ $n = 6$ cans: We have $n - 4 = 2$ extra cans for supporting jeeps performing preparatory trips. There are two basic possibilities:

i) Both supporting jeeps together perform one preparatory trip, where establish the first fuel dump B_1 and then returns to the base B. For the distance $d_1 = |BB_1|$ and for the amount of fuel s_1 stored at the first fuel dump B_1 we get the system of two equations (first equation for the preparatory trip of each supporting jeep and second one for the first trip of all four jeeps):

$$1 = 2d_1 + \frac{s_1}{2} \qquad \text{and} \qquad 4d_1 = s_1,$$

whence $d_1 = 1/4$ and $s_1 = 1$.

ii) One supporting jeep performs with 2 cans of fuel subsequently two preparatory trips. At the first preparatory trip in the distance $d_1 = |BB_1|$ it establishes the first fuel dump B_1, where stores s_1 units of fuel and then returns to the base B. Afterwards, at the second preparatory trip, it goes through B_1, where refuels up to now consumed part of fuel, then continues its way and in the distance $d_2 = |B_1B_2|$ establishes the second fuel dump B_2, where stores s_2 units of fuel. Then it returns through the fuel dump B_1, where refuels part of here stored amount s_1 of fuel needed for covering the distance d_1 to the base B. For the distances d_1, d_2 and for the

amounts of fuel s_1, s_2, stored at the fuel dumps B_1, B_2, we get the system of four equations (first two equations for the preparatory trips of one supporting jeep and last two equations for the stored amounts of fuel at the fuel dumps B_1 and B_2):

$$1 = 2d_1 + s_1, \qquad 1 = 2d_2 + s_2,$$
$$6d_1 = s_1, \qquad 4d_2 = s_2,$$

whence $d_1 = 1/8$, $s_1 = 3/4$, $d_2 = 1/6$, $s_2 = 2/3$, so the total length of two preparatory trips is $d_1 + d_2 = 1/8 + 1/6 = 7/24$, which is greater than the distance $d_1 = 1/4$ of one preparatory trip performed by both supporting jeeps (the i) case). Therefore this possibility with two preparatory trips performed by one supporting jeep is more advantageous.

The total distance performed by 4 vehicles from the base B to the fuel dump B_2 through the fuel dump B_1 is $7/24$ and they together use $4 \times 7/24 = 7/6$ cans of fuel which equals to the stores $(s_1 - 2d_1) + s\_2 = (3/4 - 1/4) + 2/3 = 7/6$. Now, in the fuel dump B2, we have 4 vehicles with 4 cans of fuel, so the maximal distance, which the chief jeep can travel, through next three fuel dumps B_3, B_4, and B_5 on the way to the target T is again $D(4,4) = H_4 = 1/4 + 1/3 + 1/2 + 1$. So the total maximal travelled distance is

$$D(4,6) = \sum_{i=1}^{6} d_i = \frac{1}{8} + \frac{1}{6} + \frac{1}{4} + \frac{1}{3} + \frac{1}{2} + 1 = \frac{19}{8} = 2.375.$$

■ $n = 7$ cans: In view of the facts described in the case of $n = 6$ we will suppose that the preparatory trips are performed by one of the supporting jeep with $n - 4 = 3$ cans of fuel. For the distances d_1, d_2, d_3 and for the amounts of fuel s_1, s_2, s_3 stored at the fuel dumps B_1, B_2, B_3 we analogously get the system of six equations:

$$1 = 2d_1 + s_1, \qquad 1 = 2d_2 + s_2, \qquad 1 = 2d_3 + s_3,$$
$$8d_1 = s_1, \qquad 6d_2 = s_2, \qquad 4d_3 = s_3,$$

whence $d_1 = 1/10$, $s_1 = 4/5$, $d_2 = 1/8$, $s_2 = 3/4$, $d_3 = 1/6$, $s_3 = 2/3$, so the total length of three preparatory trips is $d_1 + d_2 + d_3 = 1/10 + 1/8 + 1/6 = 47/120$. The total maximal travelled distance, which the chief jeep can travel, when it drives out of the base B through the fuel dumps B_1, B_2, B_3, from where sets out for the last time together with three supporting jeeps through next three fuel dumps B_4, B_5, B_6 on the way to the target T, is

$$D(4,7) = \sum_{i=1}^{7} d_i = \frac{1}{10} + \frac{1}{8} + \frac{1}{6} + \frac{1}{4} + \frac{1}{3} + \frac{1}{2} + 1 = \frac{99}{40} = 2.475.$$

■ $n = 10$ cans: We will again suppose that the preparatory trips are performed by one supporting jeep with $n - 4 = 6$ cans of fuel. For the distances d_i, $i = 1, \ldots, 6$, and for the amounts of fuel s_i, $i = 1, \ldots, 6$, stored at the fuel dumps B_i, $i = 1, \ldots, 6$, we get the system

$$1 = 2d_1 + s_1,\ 1 = 2d_2 + s_2,\ 1 = 2d_3 + s_3,\ 1 = 2d_4 + s_4,\ 1 = 2d_5 + s_5,\ 1 = 2d_6 + s_6,$$
$$14d_1 = s_1, \quad 12d_2 = s_2, \quad 10d_3 = s_3, \quad 8d_4 = s_4, \quad 6d_5 = s_5, \quad 4d_6 = s_6,$$

whence $d_1 = 1/16$, $s_1 = 7/8$, $d_2 = 1/14$, $s_2 = 6/7$, $d_3 = 1/12$, $s_3 = 5/6$, $d_4 = 1/10$, $s_4 = 4/5$, $d_5 = 1/8$, $s_5 = 3/4$, $d_6 = 1/6$, $s_6 = 2/3$, so the total maximal travelled distance, which the chief jeep can travel, when it drives out of the base B through the fuel dumps $B_1, B_2, B_3, B_4, B_5, B_6$, from where sets out for the last time together with three supporting jeeps through next three fuel dumps B_7, B_8, B_9 on the way to the target T, is

$$D(4,10) = \sum_{i=1}^{10} d_i = \frac{1}{16} + \frac{1}{14} + \frac{1}{12} + \frac{1}{10} + \frac{1}{8} + \frac{1}{6} + \frac{1}{4} + \frac{1}{3} + \frac{1}{2} + 1 = \frac{4523}{1680} \doteq 2.692.$$

Generally, for $n \geq 4$, we have the formula

$$D(4,n) = \frac{4}{3} + \sum_{i=1}^{n-2} \frac{1}{2i} = \frac{4}{3} + \frac{1}{2}\sum_{i=1}^{n-2} \frac{1}{i},$$

i.e. the formula

$$D(4,n) = \frac{4}{3} + \frac{1}{2}H_{n-2}, \quad n \geq 4. \tag{6}$$

For $n = 4$ we get, in agree with (2), $D(4,4) = 4/3 + H_2/2 = 4/3 + 3/4 = 25/12 \doteq 2.083$.

4. SOME NUMERICAL SOLUTIONS

For computation some solutions to the jeep problem with one chief and three supporting vehicles we used the procedure djp4n written in the CAS Maple programming language:

```
djp4n:=proc(n)
       local d,i,s;
       s:=8/3; d:=1;
       for i:=1 to n-2 do
           s:=s+1/d; d:=d+1;
       end do;
       s:=evalf[4](s/2);
       print("distance D(4,n) for",n,"cans is",s);
end proc;
```

Some solutions are presented in the following Table 1:

n	6	7	10	30	100	118	500	1,000	10,000
D(4,n)	2.375	2.475	2.692	3.297	3.917	4.001	4.728	5.0754	6.227

Table 1. Some amounts of fuel and corresponding distances
Source: own

For computation a number n of cans of fuel needed for overcoming u units of distance by one chief and three supporting vehicles we used the procedure ncjp4 written in the CAS Maple:

```
ncjp4:= proc(u)
        local d,i,s;
        s:=4/3; d:=2;
        while s<=u do
              s:=s+1/d; d:=d+2;
        end do;
print("number of cans needed to overcome",u,"units of dist. is",(d+2)/2);
end proc;
```

Some solutions are presented in the following Table 2:

u	2	3	4	5	6	7	8	9	10
n	4	18	118	861	6,351	46,918	346,668	2,561,538	18,927,336

Table 2. The numbers of cans needed to overcome some distances
Source: own

5. EXAMPLE

For one chief jeep and three supporting jeeps determine:
1) a maximal distance which can be reached with 30 cans of fuel,
2) a number of cans of fuel needed for overcoming 4 units of distance.

Solution: 1) For determine the maximal distance we use the formula (6) and harmonic series calculator [11]. We obtain the result in agreement with the result from Table 1:

$$D(4,30) = \frac{4}{3} + \frac{1}{2}H_{28} \doteq 1.333 + 3.927/2 = 3.297.$$

2) We solve the inequality $4/3 + H_{n-2}/2 \geq 4$, hence $H_{n-2} \geq 8 - 8/3 = 16/3 \doteq 5.333$. We use the web calculator [11]. Computing some harmonic numbers including $H_{115} \doteq 5.326$ and $H_{116} \doteq 5.335$ we get that $n - 2 = 116$. So for overcoming 4 units of distance it is necessary to have 118 cans of fuel available. This result is in agreement with the result from Table 2.

CONCLUSION

Elementary solutions to one of the interesting logistics problems – the jeep problem with one chief and three supporting vehicles – are detailed derived for small amounts of fuel. Numerical solutions for some amounts of fuel and units of distance, computed by the CAS Maple, and the general solution to this problem are presented, too.

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Acknowledgement
The work presented in this paper has been supported by the project for "Development of basic and applied research developed in the long term by the departments of theoretical and applied bases of the FMT UD (Project code: "VYZKUMFVT" (DZRO K-217)) supported by the Ministry of Defence of the Czech Republic.

BUILDING A COURSE WITH MULTIMEDIA RESOURCES – THE WORKING TIME ANALYSIS ON THE EXAMPLE OF THE PATHOPHYSIOLOGY COURSE

Magdalena Roszak and Barbara Kołodziejczak
Department of Computer Science and Statistics, Poznan University of Medical Sciences,
79 Dąbrowskiego St, 60-529 Poznań, Poland, mmr@ump.edu.pl

Abstract: *The article presents the analysis of time needed to prepare an e-learning course with multimedia for 10-hour lecture cycle in Pathophysiology for the students of the Faculty of Health Sciences at the Poznan University of Medical Sciences in Poland. The analysis covers the working time of two teams, namely the subject teachers, the course authors (A) who prepare the subject contents, and the personnel with ICT competence, in charge of drafting digital learning materials and their publication on the e-learning portal (B). The costs of preparing such an e-learning course are distributed across a few years' period of utilization. Annual accounts of the costs of groups A and B work on preparing a single multimedia lecture cycle should account for the number of participants and the limitation of organizational costs. The time needed to work on a multimedia course can be minimized through improving the level of ICT competences among professional staff (A) and through selecting an experienced team of IT specialists (B).*

Keywords: multimedia resources**,** multimedia course, working time, building e-course**,** e-learning, medical education, pathophysiology, ICT competences.

INTRODUCTION

The article presents the analysis of time needed to prepare an e-learning course for 10-hour lecture cycle in Pathophysiology for the students of the Faculty of Health Sciences at the Poznan University of Medical Sciences in Poland. The analysis covers the working time of two teams, namely the subject teachers, the course authors (group A) who prepare the subject contents, and the personnel with ICT competence, in charge of drafting digital learning materials and their publication on the on-line portal (group B). Group B members are usually the administrators of the e-learning portal. 5 persons were involved in working on the pathophysiology course: 3 teachers and 2 IT specialists. The course consists of 10 lectures, each covering a 45-minute class on the OLAT (Online Learning and Training) e-learning portal.

For several years, the Department of Pathophysiology has been involved in organization of blended-learning courses for Polish and English language speaking students within the framework of the English Programs, yet the academic year 2015-2016 was the first year for the Department to launch e-learning lecture cycles for the Faculty of Health Sciences students (https://www.estudent.ump.edu.pl).

MOTIVATION

The opinion to the effect that e-learning is more cost efficient than traditional courses and that implementation of e-learning is capable of generating immediate cost savings for the School

is not entirely true [5, 9]. The Authors' research demonstrates that e-learning is not an effective method for education costs savings; on the contrary, it can be a job requiring a lot of effort and expenses when multimedia and interactivity are implemented [9]. However, it should be borne in mind that the costs of preparing such an e-learning course are distributed across a few years' period of utilization [8]. A 5-year life cycle of contents is expected. Thus, the costs of course preparation should be divided by the number of classes held across an approximately 5-year period. Creating courses with shorter lives is not cost efficient and would in fact discourage the implementing team, particularly the course authors, from making such a significant effort (employing such significant time) as necessary for preparing good quality, reliable subject-matter contents. Therefore, adequate remuneration for work on preparation of distance learning courses, as well as appropriate legal regulations in place at Universities regarding organization of e-learning classes are a necessity for the development of this teaching method. Non-existence of these factors is still a withholding factor in Central and Eastern Europe for the application of e-learning in the academic education system [10].

The purpose of the article is to review the time needed to work on a sample e-learning course with the objective of involving multimedia lectures in the teaching process in Pathophysiology. The purpose of this analysis is to demonstrate to decision makers (coordinators in charge of implementation) that the work on a good e-learning course is a highly time consuming activity and should be pursued in cooperation with experts in the field of distance education as well as people with adequate competences in the field of IT [4-7].

1. COURSE PREPARATION ON AN E-LEARNING PORTAL

The following 3 parts can be distinguished within the entire Pathophysiology course on the e-learning portal:

A. organizational part,
B. professional part,
C. communication part.

A. The organizational part of the course comprises the syllabus of the subject and the class schedule. The subject coordinator (group A) is responsible for subject-matter preparation of this part of the course.

B. The professional part of the course consists of multimedia lecture materials and self-tests (interactive resources). The e-learning course in Pathophysiology consists of 10 modules with the following subject-matter components:

1. **a multimedia presentation** in which the teacher discusses the issue at hand on the basis of pre-developed contents - text, diagrams, photos and models. It is an mp4 video file which the student can play repeatedly at anytime, anywhere they choose. The duration of a single presentation depends on the topics of the lecture, ranging from 12.2 to 32.5 minutes (comprising 23 to 51 slides); the average duration of all 10 lectures is 25.4±5.8 minutes (the average number of slides in all the 10 lectures is 34.8±10.7 slides).
2. **self-test** "Test yourself!" (**practical part),** consisting of 6 multiple-choice questions with 4-5 answer options, randomly selected for each student out of the database of 20 questions. The student will verify their own knowledge of the subject after listening to the audio presentation. The self-test can be launched up to 3 times and the time for solving the test is 6 minutes; students can practice at anytime, anywhere, using any computer connected to the Internet.

3. **analysis of selected problems** (**practical part**), i.e. a test composed of 6 advanced questions with additional clarifications, guidance and auxiliary questions for the issues at hand, to help students in their learning and guiding them towards the solution of the specific problem. The purpose of this test is to prepare the student for working on clinical cases during local classes. There is no time limit for solving the test, and the student can launch the test multiple times according to their own needs, working with the test at anytime, anywhere, using a computer connected to the Internet.

C. The student-teacher and student-student communication options constitute a very important part of every e-learning course [3]. Within the Pathophysiology course, students have the following communication channels available:

- *Notifications* – this is a location within the course with short messages regarding certain key events, such as changes in the organization of local classes, test results, dates of exams. These messages can be sent by course teachers or portal administrators.
- *General forum* – here the teacher can communicate information to students and each student can ask a question to the teacher or other students. With the multiple-thread structure of the forum, discussions regarding subject-matter topics and administrative matters are allowed.
- *Ask the teacher* – students can use this option to ask the teacher individual questions via e-mail. The teacher can reply to this particular student, or to a selected group of students, or to all the course participants, using the forum options. This method of communication is available for every topic module.
- *Problem with the portal* – this is a way for students and teachers to communicate with the portal administrators. A message will be sent via e-mail to indicate any site malfunction, e.g. no access to site resources.

Preparing a course with the specified structure is a time-consuming undertaking (ca. 8 hours), requiring good command of the e-learning portal tools. Nevertheless, it is reasonable to dedicate a certain time to considering the course organization and resources, so as to avoid confusion among students, particularly those who encounter this class organization or support method for the first time. In addition, LCMS portals provide course archiving and copying tools; thus, a well planned and tested course can be used more than once.

Further in this article, we will focus on the analysis of time needed to develop the professional course contents (specified under sections B.1., B.2., B.3.) by the implementing personnel, i.e. groups A and B.

2. THE WORKING TIME ANALYSIS ON MULTIMEDIA AND INTERACTIVE RESOURCES

2.1 Work on the multimedia presentation

The following activities are included in the scope of preparing a multimedia presentation by the teacher (group A):

1) development of the subject-matter lecture contents in the form of presentation (static text with graphics, tables, diagrams, drafts), and
2) preparing audio contents (commentary) in the form of verbal description (transcript) to every slide in the presentation.

Subject-matter contents would be usually saved to .pptx file and transcripts to text files (usually .docx format). The working time needed for preparation of subject-matter contents in the form of a presentation ranged from 7.7 to 17 hours; average: 11.6±3.6 hours, depending on the number of slides per presentation (min.= 23; max.= 51). On the other hand, the time to work on the transcript, depending on the number of slides in the presentation, ranged from 1.9 to 5.8 hours; average: 4.08±1.3 hours. Transcript length data, i.e. word count/character count, with and without spaces, are shown in Table 1. It should be emphasized that the specified data refers to the time needed to work on materials prepared by teachers from scratch for a specific e-learning course. The study also includes the time which the teacher had to dedicate to reading the most recent bibliography references and editing the relevant contents and choosing or preparing images, diagrams or drafts. Every presentation was produced by the teacher directly.

No.	Transcript	Mean±SD	Median	Min.	Max.	Sum
1.	Number of words	2258.2±713.8	2303.5	1027	3248	22582
2.	Number of characters without spaces	15734±4931.7	16371	7352	22381	157340
3.	Number of characters with spaces	17962.2±5674.5	18655	8369	25648	179622.3
4.	Number of pages (2200 characters with spaces)	8.2±2.6	8.5	3.8	11.7	81.6

Table 1. Word and character counts in transcripts for presentation
Source: own

The next stage of preparing multimedia presentations is the recording of presentation comments by the teacher (audio resource), in cooperation with the IT specialist (group B). The teacher reads the transcript (slide comment) and the IT specialist is responsible for recording audio with the appropriate software in a recording studio. The recording will be repeated or adjusted if necessary. The Department of Pathophysiology cooperates with the Poznań Supercomputing and Networking Center (PSNC) with its Voice Interface Technology for New Generation Services Laboratory, which enabled the Department to achieve a professional audio recording for the course. Thus, this phase was executed outside the University, and every teacher had to make an individual appointment with a group B member at a convenient time for both parties, according to the availability of the recording studio.

When commencing the recording process, group A and group B members had already had certain experience working at the PSNC, and therefore the work was proceeding smoothly and the time needed for the recording was optimized, depending on the length of the presentation only. However, it should be emphasized that the transcript should be written in a readable version, and a reader was not hired for this course for financial reasons, and the actual recordings were produced with the participation of the authors of the subject-matter contents. In the case of the Pathophysiology course under consideration, the time for recording the audio of the lectures was ranging from 25 to 91 minutes and the average for all the 10 lectures was 61.8±22.8 minutes. Naturally, time to travel to the studio and back and duration of breaks during the recording should be added to the actual duration of recording – at least 15 minutes for recording a single presentation composed of ca. 24 slides. However, this component depends on the teacher and on the volume of recorded text.

If the teacher takes part in audio recording for the first time, without prior experience in the field, they will be able to record sound for 10-15 presentation slides in 60 minutes, using a prepared transcript. Recording audio without a transcript, e.g. of approximately 8 minutes of

audio (for a 7-10 slide presentation) takes much more time, namely 2.5-3 hours, which is highly inefficient and as such not recommended by the Authors.

Further stages of working on the learning resource in the form of a multimedia presentation are covered by group B members only.

2.2 Audio resources editing

The soundtrack should be recorded to the best possible quality, i.e. at sampling frequency 44.1 kHz and resolution 16 bit (CD Audio quality). The recorded teacher comments need to be processed further through cutting out unnecessary interruptions or adding silent parts, usually at the beginning and at the end of the recording, silencing reader breathing-in sounds, clearing their throat, and other unnecessary background noise. Typically, 3 hours of work on soundtrack is necessary for 1 hour of audio. The outputs can be saved to a lossy compression format at this stage, for example to mp3. The Authors applied compression only at the time of mounting the video version of the presentation.

2.3 Preparation of educational graphics

The learning materials, e.g. in the form of PowerPoint presentations, various types of photos or images in the presentation need to be pre-processed as well, including cropping, size and resolution consolidation, and saving in a single consistent format. It may be recommended to use graphic file editors or browsers which would automatically apply such conversions to entire folders, thus offering significant time savings. This is referred to as batch processing. The time needed to process graphic materials of e.g. 30 photos is ca. 3 hours of work for a person experienced with the relevant software. The time needed to search and learn new software must be added for a beginner who is just starting work with graphic software [4].

2.4 Creating video materials

The learning materials prepared with the audio comment will then be merged and saved in video format. The choice of output format and therefore of audio and video track codecs needs careful consideration. If the video is intended for distribution via a Web page server, formats accepted by <video> tags by most Internet browsers should be used. Irrespective of the attempts at standardizing audio and video files in HTML 5, playing multimedia files on client PCs is still a major problem. It is most commonly due to missing codecs for decoding audio and video streams; therefore, the most popular ones should be selected. Another problem is the video and audio quality and the related size of the output video file. Despite the compression tasks, such files are multiple megabytes in size. Excessive compression will cause excessive inconvenience for viewers. On the other hand, with good audio quality and image size retained, file downloads can be lengthy or even impossible, considering the waiting time for transmission of such volume of information. This issue is mitigated by the use of streaming media server. Then, even with a slow Internet connection, multimedia will be played without interruption, only with pauses needed to download appropriate portions of data. Because education institutions do not usually have a streaming server and are reluctant to use third party multimedia servers such as YouTube, their only choice is to reasonably determine the audio and video stream quality.

Like in the case of audio and graphic materials preparation, we have to choose the right software for creating video files. There are many commercial and open-source software

packages available on the market. According to the available funding and the IT expertise, you can choose simple GUI software with lower performance, or more advanced yet less user-friendly software. Among the important software selection criteria, the set of output formats should be specifically considered that will be used for storing video files, as well as the available options for video and audio track quality.

The authors used FFmpeg, which is a GPL freeware package. This multiple-platform software (Windows, Linux and Mac) is used to record, convert and stream audio-video contents [1]. The software has extensive audio and video track management options. The main disadvantage is the lack of a graphic user interface. The software works in console mode and commands have to be entered in the command line. Nevertheless, with the ability to create and execute scripts with command sets, the time needed to prepare video files becomes significantly shorter.

The authors made the assumption that the time to play individual video materials should not exceed 45 minutes. Longer pieces were divided into parts, so that the average length of video in the complete materials was 25.4 minutes. In addition, considering that the materials were to be distributed via an e-learning portal without the streaming service, attempts were made at reducing the sizes of video files, at the expense of quality, yet maintaining the reasonable balance. A lot of time was spent on experimental determination of such compression parameters that would generate small output files in reasonably good video and audio quality. This goal was successfully accomplished with the selected software. For example, a 23 min 31s mp4 video file with 1066x600 pixel resolution is only 15.4 MB in size. The time to prepare such a video out of ready-made materials (presentation and soundtrack) in the software package referred to above is only 20 minutes.

2.5 Embedding multimedia resources on the e-learning portal

The OLAT portal which is used by the Authors for distance learning purposes requires embedding video materials on the Web page. To do this, one has to be familiar with specialized HTML editor tags or use, such as kED or PSPad [2]. Then, multimedia files need to be transferred to the e-learning portal which, depending on the Internet connection speed, takes 2-5 minutes per file. Finally, the resources need to be embedded and the course interface needs to be configured, which takes 15 more minutes. If you need 30 minutes for the above mentioned activities on a single multimedia resource, embedding 10 lectures in a course will take you 5 hours.

2.6 Working on the practical part (self-tests and specific problem tests) – interactivity

The time needed to create a database of 20 self-test questions included the working time of the teacher on the subject-matter contents of the questions and the time to save the questions in Question and Test Interoperability (QTI) standard [7, 8] used by default in on-line knowledge evaluation on e-learning portals.

The teacher's working time needed for preparation of subject-matter contents of 20 questions with 4-5 answer options in a text file (.docx format) ranged from 40 to 150 minutes; median = 150 minutes. The total time needed for teachers to prepare a database of 200 questions for 10 self-tests within a course was 1110 minutes, i.e. nearly 18.5 hours. Saving of these 200 questions in QTI standard (group B) included setting the parameters for each question [7, 8], such as single registration of the answer to the question, randomized presentation of answer

options, random selection of questions from the database for a student. The time spent by the group B member working on the QTI file for the database of 200 questions ranged from 433 to 512 minutes, i.e. from 7.2 to 8.5 working hours (7.9 working hours on average).

The next step was to build a dedicated test for in-depth analysis of selected problems for which the teacher was preparing substantive contents (additional explanations, guidance or auxiliary questions) for the whole question or for each answer option separately.

The time spent by the teacher on preparing the subject-matter contents for the 6 problems ranged from 30 to 120 minutes, with the average working time being 75.3±34.9 minutes (median = 60 minutes), while the aggregate teachers' working time on 60 problems for 10 lectures was 678 minutes, i.e. 11.3 hours of work. Registration of these contents in the selected 60 questions in the QTI standard was the responsibility of a group B member and took 330-374 minutes, i.e. 5.9 hours of work on average.

3. WORKING TIME ON PATHOPHYSIOLOGY LECTURE COURSE – SUMMARY

Table 2 presents the time that was necessary to complete an e-learning lecture course for 10 lectures in Pathophysiology with multimedia resources. This is the working time for 5 persons – members of a multidisciplinary team working on building the course, namely the professional authors (group A) and the persons in charge of the technology/IT aspect (group B).

Section of the chapter	Staff	Detailed calculations	Working time (hours)
1.	B	total time	8
2.1. 1)	A	20 minutes x 348 slides	116
2.1. 2)	A	30 minutes x 81.6 pages	40.8
2.1. 2) at the PSNC	A	total time	10.3
2.1. 2) at the PSNC	B	total time	10.3
2.2	B	3 minutes x 254.1 minutes (audio)	12.7
2.3	B	6 minutes x 348 slides	34.8
2.4	B	7 hours (experimental determination) + 20 minutes x 10 video files	10.3
2.5	B	total time	5
2.6 self-tests	A	total time	18.5
2.6 self-tests	B	total time	7.9
2.6 problem tests	A	total time	11.3
2.6 problem tests	B	total time	5.9
TOTAL	**A, B**	Group A: **196.9 hours (67 %)** Group B: **94.9 hours (33 %)**	**291.8 hours**

Table 2. Analysis of time required to prepare a course for Pathophysiology lecture cycle
Source: own

The professional workers (group A) have no IT background and therefore they needed more time for performance of their tasks (196.9 hours) than originally expected. This comment may apply to teaching staff, particularly of non-technical universities, even more so when they are involved in such a project for the first time. High involvement of the academic teacher also

demonstrates their enormous commitment and care about the quality of the professional materials.

The smaller percentage (33 %) of the IT team (group B) in the overall working time related to the course is the consequence of the work automation (software development) competences and extensive experience in creating and publishing multimedia resources for e-learning purposes. It should be expected that the percentages of working time by groups A and B will become more balanced in the course of creating further multimedia materials.

The life cycle of subject-matter course contents is expected at 5 years [8]. Therefore, the 291.8 hours of work of the team producing a 10-hour multimedia lecture course in pathophysiology should be divided by five, so that we arrive at 58.4 hours of work per academic year. Thus, the project seems to require more effort than a traditional course in class. However, it should be borne in mind that an e-learning course, in addition to the professional content as such, gives students the opportunity to verify their knowledge through self-tests and case study tests with suggestions and additional explanations from the teacher. This makes this teaching method more attractive, the teaching process more personalized, and affects the course efficiency, which the Authors are going to demonstrate through subsequent research.

A traditional lecture can be offered to such a number of students that can be accommodated in a lecture hall, while there is no such limitation for an e-learning lecture. An e-learning course in pathophysiology was held during the academic year 2015-2016 at the following faculties: nursing (67 students), emergency medical service (46 students), physiotherapy (85 students), and obstetrics (76 students). It was attended by 274 students. Annual accounts of the costs of groups A and B work on preparing a single multimedia lecture cycle (58.4h) should account for the number of participants (close to 300) [5, 6] and the limitation of organizational costs, e.g. elimination of the costs of renting the rooms.

CONCLUSIONS

Preparation of an e-learning course with multimedia materials is a multi-stage, time consuming process. Thus, the structure and the learning contents of the course need to be carefully reviewed, so that the course can be effectively used by teachers and students for several years. The course organization should be logical and legible for users, and navigation should be user-friendly. A student should be able to find all the necessary information in the course, starting with the syllabus of the subject, through a time schedule, to professional subject-matter contents. In addition, the course should facilitate building a community of learners through offering communication tools to students and enabling students to feel supported by the teacher.

Preparation of the learning materials is the central and most time-consuming phase of course development, particularly when the materials are multimedia-based. Preparation of updated learning contents followed by digitization is a task for a team of teachers and IT specialists. Effective cooperation at every stage is the basis of success. Through creating educational resources, the ability to verify the level of acquired knowledge or to apply this knowledge to specific problem cases cannot be disregarded. This is the function of question checklists at ends of chapters in textbooks, and of self-tests in digital courses.

Summing up, the time needed to work on a multimedia course can be minimized through improving the level of ICT competences among professional staff (group A) and through selecting an experienced team of IT specialists (group B). Also, good cooperation between groups A and B should be assured, as it is indispensable for the overall project success. Implementation of the e-learning course in pathophysiology was a good example of this rule.

The life cycle of subject-matter course contents is expected at 5 years. Annual accounts of the costs of groups A and B work on preparing a single multimedia lecture cycle should account for the number of participants and the limitation of organizational costs.

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Acknowledgement
The authors render cordial thanks for participation in the research to the following staff members of the Department of Pathophysiology at Poznan University of Medical Sciences: prof. UM dr hab. Katarzyna Korybalska, dr hab. Dominika Kanikowska, and dr Barbara Kupczyk. We direct our special thanks to mgr Mariusz Owsianny of the Poznań Supercomputing and Networking Center for our cooperation and professional assistance granted during realization of recordings at Voice Interface Technology for New Generation Services Laboratory.

MOOCS AS AN ALTERNATIVE TOOL FOR PROVIDING ACCESS TO EDUCATION FOR REFUGEES: A PILOT STUDY IN TURKEY

Iryna Sekret[1] **and Bülent Döş**[2]
[1]Abant Izzet Baysal University
Gölköy Yerleşkesi, 14280 Bolu, Turkey, irenesekret@gmail.com
[2]Gaziantep University
Üniversite Bulvari, 27310 Şehitkamil – Gaziantep, Turkey, bulentdos@yahoo.com

Abstract: *The study is aimed to bring to the discussion the problem of providing access to education for refugees via MOOCs (Massive Open Online Courses) as a tool which may contribute to developing an individualized path to education and, therefore, a quicker adaptation to the environments of the hosting countries for refugees. With this purpose the educational potential of the MOOCs to meet refugees' learning needs is analyzed based on the responses from the university instructors on their usage of ICT tools in teaching, general attitude towards MOOCs and applicability of MOOCs to the refugees' situation. The methods of the study include literature review, observation, analysis of recent case studies, and semi-structured interview. Based on the research results and analysis of the current practices of MOOCs designed for the learning needs of the refugees in different countries, the paper outlines in brief the learning needs which may be targeted by MOOCs and perspectives of involving the university instructors from Turkey to the MOOCs practices.*

Keywords: MOOCs, online learning, refugees, learning needs, socio-cultural adaptation, language education.

INTRODUCTION

With the boost of the migration crisis all over the Europe and in the countries neighboring the war-affected areas, the problem of the migrants and refugees adaptation to the hosting environments come as the most urgent one. The problems faced by the migrants i.e. lack of cultural and language competences, discrepancies between their educational degrees and the requirements for being employed, cause disturbances in the hosting societies and make migrants feel complete alien with no perspectives for the future.

To meet the problems and to find a solution mean to provide education which would facilitate adaptation and further employment of the new comers. But the situation does not improve significantly when it concerns the migrants' enrolment into traditional educational institutions. The language barrier, cultural differences, age differences, mismatches in the levels of educations, economical complications, formal requirements on enrolment - all of them become obstacles for the application to the institution in the first place, and then for the completion of the educational program [5].

Considering the circumstances of the migration crisis and in search for the optimal solutions, online learning is currently discussed as a strongly potential way to provide an alternative solution for the traditional education and to meet the migrants' needs for intensive and adaptive education [5].

Among different forms of online learning MOOC (Massive Open Online Courses) are under consideration to provide learning for the refugees and migrants.

As far as this way of learning has been already in practice in some countries of Europe, USA and Middle East the current study concerns the problems of adjustability of MOOCs for the migrants' learning needs in Turkey.

With this concern the paper discusses the benefits of MOOCs for migrants and refugees, some practices of MOOCs for refugees in the world, the situation and attitudes towards MOOCs in Turkey. Besides, the research is bringing the results of the survey concerning the university instructors' usage of ICT tools in their teaching practice in order to estimate their potential for online learning and teaching, and their views and perspectives on MOOCs for the refugees in Turkey.

The methods of the study include literature review, survey, observation, analysis of the case studies and semi-structured interview with the university instructors. The paper concludes with outlining main tendencies concerning implementation of MOOC for the refugees' learning needs in Turkey.

The findings may be helpful for the estimation of perspective of MOOCs in different countries and developing frameworks appropriate for different educational environments. Based on the research results and current experiences of MOOCs designed for the learning needs of the refugees in different countries, the paper provides recommendations on establishing, effective launching and implementation of MOOCs for refugees, concerning their needs and socio-cultural specifics.

1. MOOCS AS AN ALTERNATIVE MEANS OF EDUCATION TO PROVIDE ACCESS FOR LEARNING TO REFUGEES AND MIGRANTS

1.1 Benefits of MOOCs to Provide Access to the Education for Refugees and Migrants

MOOCs are defined as courses designed for large numbers of participants, that can be accessed by anyone without entry qualifications, and offer a full/complete course experience online for free [4].

UNESCO and the Commonwealth of Learning (COL) joined their efforts to develop a guide to massive open online courses (MOOCs), where open and online education is seen as an innovation driver for improving education and as a basis for transforming secondary and higher education systems. In this respect, MOOCs are viewed to be excellent for promoting lifelong learning [7].

Among benefits of MOOCs which may serve for the learning needs of migrants and refugees are the following [7]:

1. Courses are offered free-of-charge to any number of people, anywhere and anytime, therefore, MOOCs enable access to higher education and beyond for people who cannot afford a formal education and are disadvantaged.
2. MOOCs can reduce the disconnect between the skills and aptitudes of the majority of university graduates and the needs of the industry sector in many countries. This

disconnect is triggering huge unemployment amongst youths and adults, particularly women.

3. MOOCs can be useful in providing job-oriented training and skills development.
4. MOOCs emerged from the open education movement. As such, they enable free access to high-quality content and resources, which might be too costly for higher education institutions in developing countries to produce.

1.2 Provision of MOOCs for the Refugees in the World

Due to the present evidence the provision of MOOCs in Europe and other continents tends to grow [4].

According to the recent Babson Survey 2.6 percent of higher education institutions currently have a MOOC, another 9.4 percent report MOOCs are in the planning stages. The majority of institutions (55.4 %) report they are still undecided about MOOCs, while under one-third (32.7 %) say they have no plans for a MOOC. However, the academic leaders remain unconvinced that MOOCs represent a sustainable method for offering online courses, but do believe they provide an important means for institutions to learn about online pedagogy [1].

Mazoue (2013) indicates that many universities might choose to offer MOOCs on the basis that they would not pose a threat to their residential operations. It means MOOCs can be used as an non-formal education courses for public education. Because even it has no teacher-student interaction Bruff, Fisher, McEwen and Smith [3] finds that students accepts MOOCs course videos as a valuable sources for learning. They also points out MOOCs can serve as useful learning resources as part of a blended course.

The implementation of MOOCs may be hindered because of diverse languages, cultures, settings, pedagogies and technologies [6].

Considering MOOCs for the learning needs of refugees the currently existent practice should be mentioned. Among them:

- Kiron online university for refugees (Germany). Kiron is a crowdfunding project, conceived to give refugees access to higher education. Programs are a combination of two years of online studies and one year of classroom studies at a partner university. The program is provided in English, German, and Arabic (http://www.dw.com/en/kiron-education-for-refugees/a-19311256)
- The University of Louvain (Belgium). The University of Louvain together with the Croix-Rouge de Belgique offer asylum-seekers to (re)connect with the university education via its MOOCs program, a set of online courses open to everyone (https://www.uclouvain.be/en-mooc-refugees.html);
- Coursera for Refugees. The U.S. Department of State and massive open online course provider Coursera are partnering to launch Coursera for Refugees, a program to offer career training to displaced people around the world. The program focuses on nonprofits that help refugees, which will be able to apply for fee waivers to access the Coursera course catalog. The organizations will then be able to offer free access to MOOCs to the refugees they serve. Coursera is the latest MOOC provider to offer educational services to refugees. Earlier this year, edX partnered with Kiron, a free education provider for refugees, to offer college credit to Syrian migrants. (https://www.insidehighered.com/quicktakes/2016/06/20/launch-moocs-refugees-program);

- Edraak – MOOC platform. Edraak, is a massive open online course (MOOC) platform, that is an initiative of the Queen Rania Foundation (QRF).Through its partnership with edX, the platform gives Arab learners access in Arabic to courses taught and developed at top tier institutions like HarvardX, MITX, and UC BerkelyX. All courses are delivered at no cost to the learner. QRF envisions the use of the platform to showcase Arab role models by broadcasting short online courses by practitioners and professionals from a variety of fields spanning the arts and sciences (https://www.edraak.org/en/courses/).

Analysis of the practical implementation of MOOCs in the refugee camps reveals the following specifics:

1. Female participation is rather low due to the household responsibilities or insufficient digital skills;
2. More than 90% of MOOCs participants are male;
3. Computer illiteracy may hinder the participation, at the same time it may trigger learning curiosity of the students regardless of their age and prior learning experience;
4. Navigating MOOC platform may be a challenge for new learners, they may need support from facilitators located in their areas;
5. Insufficient number of equipment may cause troubles for consistency of session attendance and fulfilling learning assignments;
6. Low levels of interactivity in MOOC design may become frustrating, therefore, the presence of the learning facilities in camp may be helpful;
7. Offline meetings are essential to facilitate understanding via face-to-face discussions and clarifications;
8. Preferences in online learning are given to those courses which develop knowledge and skills transferable to the needs of the local community.

2. PERSPECTIVES OF MOOCS FOR THE LEARNING PURPOSES OF REFUGEES AND MIGRANTS: A PILOT STUDY ON NEED AND FEASIBILITY IN TURKEY

2.1 Methods

This study was designed to collect data from instructors and academicians to get insights about perspectives on implementing MOOCs for refugees. For the purposes of the study a semi-structured questionnaire was developed by the researchers.

The first part of the instrument collects the data on the type of institution, the number of students, the number of refugee students and socio-economic status of the school.

The second part of the questionnaire inquiries about technologies applied for teaching (e.g. Which technologies do you have available for your teaching?, etc.).

The last part of the survey collects the data about the views of the participants on MOOC and possibilities to implement MOOCs for the learning needs of refugees (e.g. Have you had any experience with MOOCs?, etc.).

The participants were selected from universities located in different parts of Turkey. 30 questionnaires were dispersed to the participants and 22 of the surveys were returned answered. Totally 22 questionnaires were analyzed from 8 universities.

2.2 Findings

The majority of the participants replied that they use technological tools in their teaching process. The implementation of ICT tools occurs in their face-to-face teaching (Table 1).

No	Tools	Frequency
1	Desktop Computers	12
2	Large screen digital display	9
3	Audi-visual recording or editing equipment	6
4	Tablets or smart phones	5
5	Physical manipulatives (blocks/other objects)	3

Table 1. Technological tools respondents use in teaching
Source: own

Most of the participants didn't have any online or distance teaching courses, therefore they don't use any online teaching programs or websites. No mention was on usage of such MOOCs as Coursera, or the tools as Blackboard, Merlot etc. The ICT tools and resources utilized are generally known and widely applied in teaching practice (Table 2).

No	Tools	Frequency
1	Youtube	14
2	Moodle	10
3	Facebook	7
4	Wikipedia	4
5	Edmodo	4

Table 2. Websites and online resources participants use
Source: own

As it becomes obvious from the responses the instructors tend to apply commonly knows ICT tools and resources. They often refer to the open online courses to get information on the content concerning their courses. A few respondents indicate that they are using audio and video recording/edition tools to create their own content. The participants stated they use YouTube mostly in their teaching process as an online resource.

Having no or little experience on MOOCs, the respondents expressed their positive attitude towards to this form of online learning (Table 3).

No	Items	Agree	Neutral	Disagree
1	MOOCs are a sustainable method for offering courses	19	3	-
2	Credentials for MOOC completion will cause confusion about higher education degrees	-	-	22
3	MOOCs are important for institutions to adapt new teaching practices	21	1	-
4	MOOCs can be a solution to provide access to education for refugees	22	-	-
5	MOOCs can be more beneficial for refugees than traditional classes	16	4	2
6	MOOCs are not appropriate for refugees' educational needs	2	2	18

Table 3. Participants' views about MOOC
Source: own

As it comes from the data obtained the respondents are quite positive about implementation of MOOCs in higher education institutions for refugees. They agree that MOOC can be a sustainable method for the higher education considering problems experienced by refugees in learning. They also think that MOOCs can be a better solution than the traditional classroom in case of the refugees' learning needs.

2.3 Discussion

The pilot research conducted within this study indicates that instructors-respondents from different universities in Turkey apply technological tools in their teaching process. They prefer to apply commonly known tools and resources searching for the content applicable for their courses. They use open educational resources and report on little use of ICT tools for creating their own teaching content and materials. Most of the respondents answered that their institutions do not provide online education, therefore, we may assume, that they do not have much experience of creating their own teaching materials and conduct an online course consequently. Concerning this situation and with the perspective of developing online courses in the universities the instructors should be trained on using ICT tools for creating teaching materials and teaching online.

Together with that it can be assumed that universities have enough of the technical supply to provide an access to open educational resources, and, considering the instructors' positive attitudes towards MOOCs, they may follow the MOOC courses gaining the experience and an idea on teaching/learning within MOOC.

CONCLUSION

To conclude with the study it can be assumed that MOOCs as an alternative means of providing access to education may have strong potential for the refugees and migrants to

solve the problems of the language barrier, adaptation to the hosting communities and employability.

At the same time a number of factors should be taken into consideration:

1. The MOOCs should target the refugees' immediate learning needs which include: language education; adjusting refugees' education to the formalities and content of the formal educational institutions; raising intercultural awareness; programs on applied skills due to the market requirements and jobs in need.
2. The technological realization of the content should be affordable for the refugees' conditions and accessible via mobile phones and other portable applications providing access to Internet.
3. Despite the limited experience of MOOCs usage and their offers in Turkey the instructors demonstrate positive attitude towards such form of online learning, and, therefore, can be involved in the process of MOOCs approbation and dissemination among migrants and refugee students.
4. The institutions of Turkey may be considered for the participation in the MOOC development if the instructors are provided with the training on implementation of ICT tools for creating teaching content and teaching in the online learning environment.

To proceed with the study the refugees and migrants should be interviewed on their actual learning needs, problems they encounter in education and their readiness to follow MOOCs in order to outline the content, methods of online teaching and affordable ICT applications.

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DESIGNING MODULE "PRESENCE AND ONLINE TUTORING" FOR THE MASSIVE OPEN ONLINE COURSE "ICT TOOLS FOR E-LEARNING"

Iryna Sekret[1] **and Nataliia Morze**[2]
[1]Abant Izzet Baysal University
Gölköy Yerleşkesi, 14280 Bolu, Turkey, irenesekret@gmail.com
[2]Borys Grinchenko Kiev University
18\2 Vorovskogo Str, Kyiv, Ukraine, n.morze@kubg.edu.ua

Abstract: *The authors disclose their experience of designing one module of the course, considering main steps in the process, specifics of the teamwork, the module's structure and content, forms of the teaching material representation, ICT tools applied. The study is accompanied with a list of problems which were encountered during the process of the module design, and solutions found in the process of work. Due to the fact that MOOC remains to be a pedagogical novice and there is a scarcity of instructions on designing the MOOC course, the study is believed to contribute to the development of the MOOC methodology and instructional design in online learning by sharing actual experience and discussing applied problems. The methods of the research include literature analysis, reviewing the findings of the recent projects and case studies in the area of MOOC, analysis of the authors' own experience.*

Key words: MOOC, instructional design, course, module design, online pedagogy, ADDIE Model, e-learning.

INTRODUCTION

Nowadays the notion of online learning is already very well known to all stakeholders of education while forms and modes of its delivery continue to develop due to the rapid enhancements in the ICT area and an urge to adjust educational services to the needs of learners.

We are witnessing an undergoing a global change in the education system which is caused by the necessity to provide multisided development to the learners in order to prepare them to live in an open information space, to shape the skills required for the 21st century, ensuring their continuous lifelong learning in both formal and informal formats. In this respect it is essential to establish flexible interaction between different social, economic and technological developments in the field of education in a global context with a special focus on designing new tools and means of open education.

One of the latest trends in the online learning is the establishment and escalation of MOOC (Massive Open Online Courses). After its emerge in Canada in 2008, MOOC has spread round the globe, involving more and more institutions in designing MOOCs and reaching broader masses of learners with different educational and cultural backgrounds.

Presently various institutions report on different interests of being actively involved in designing MOOCs. Thus, Duke University shows that students choose MOOC for several reasons [10]:

- To support lifelong learning or gain an understanding of the subject matter, with no particular expectations for completion or achievement;
- For fun, entertainment, social experience and intellectual stimulation;
- Convenience, often in conjunction with barriers to traditional education options;
- To experience or explore online education.

The institutions' purposes range from the intention to promote the brand of the school at the market of the educational services to the desire of researching and experimenting within new online pedagogy.

The endeavor to develop the module "Presence and Online Tutoring " within the MOOC "ICT Tools for E-learning" were missioned by the IRNet project – "International Research Network for study and development of new tools and methods for advanced pedagogical science in the field of ICT instruments, e-learning and intercultural competences" (http://el.us.edu.pl/irnet/).

This study focusses on the problems and experiences of designing a module of the MOOC in order to bring to the discussion the problem of developing appropriate teaching materials, concerns about the MOOC content, teaching methods and procedures together with the issues of establishing teamwork and its coordination in conditions of ICT-mediated learning.

Due to the fact that more and more instructors and institutions are facing the need to join the mainstream of providing online learning to broader circles of learners above those who are officially enrolled in the institution, the experience described in the paper may be helpful for those who are in the beginning of this path. Together with that, it is believed to contribute to the overall discussion of the problems concerning MOOCs pedagogy and development of new forms and methods of online learning.

In the context of the research the paper provides a brief overview on the issues concerning the definition of MOOCs and its distinctive features, how MOOCs differ from other forms of online learning, possible scenarios of MOOCs provision and the author's insights on the development of the module "Presence and Online Tutoring".

The methods applied to reach the aims of the study include literature analysis, reviewing findings of the recent projects and case studies in the area of MOOC, analysis of the author's own experience.

1. DEFINING MOOCS

1.1 Defining MOOC: Distinctive Features and Models

MOOCs are courses designed for large numbers of participants, and can be accessed by anyone and anywhere as long as they have an internet connection, MOOCs are open to everyone without entry qualifications, and offer a full/complete course experience online for free [2].

As William Gibson says "*The future is already here, it's just not very evenly distributed*", and that is true of MOOCs. Recently MOOC has been in the centre of all education stakeholders but it must be stressed 'all MOOCs are not created equal' and there are lots of species of

MOOC. This is good and we must learn from these experiments to move forward and not get bogged down in old traditionalist and modernist arguments. MOOCs will inform and shape what we do within and without institutions. What is important is to focus on the real needs of real learners [1].

The key characteristics of MOOCs are defined to include: varied definitions of openness, barriers to persistence, and a distinct structure that takes a form of one of two pedagogical approaches - the pedagogical structure of the connectivist MOOC model (cMOOC), or the conventional directed instruction in the context of the formal postsecondary educational institutions categorized as cognitive-behaviorist model [9].

Openness is known as one of the core components of a cMOOC, along with self-organization, connectedness, and complexity. Openness of information flow is a vital characteristic of a self-organizing complex system. cMOOCs are situated within open and distance learning initiatives, which are characterized by: (a) open technology and open software for educational purposes; (b) open content and open educational resources; and (c) open knowledge in which participants and facilitators openly share educational practices.

Barriers to Persistence in MOOCs are stressed to cause high drop out rates. Among the factors leading to the dropout are:

1. technology skills may become impediments to learning given the wide variety of tools used in the course;
2. for non-native English speakers, language skills could be a barrier when web conferencing sessions are facilitated in English;
3. for novice learners, the chaotic nature of the cMOOC may turn problematic since there is a lack of a coherent, centralized structure and the students' learning is not summarized or synthesized;
4. time zone differences, difficulty of meeting up with others online, challenges of making social connections;
5. time constraints as a major barrier for adult lifelong learners in established professions.

The factors and conditions for elaborating the new MOOCs in higher institutions entail [4]:

- Motivation from side of students, which study and will work in conditions of digital space, global world economy;
- Dynamic development of new competences, new professions, new skill which require permanent improvement of qualifications;
- Self-study, lifelong learning, sometimes with no requirements for monitoring results;
- New ICT-technology and creative tools for elaborating MOOCs;
- Solutions and regulations on the formal and legal aspects, which would provide a possibility for gaining qualifications, and successful completion of MOOCs be regarded as formal educational achievement (ECTS credits) for students within both informal and formal education.

Considering models of MOOCs it should be noted that MOOCs began with a connectivist model targeting an adult lifelong learning audience. The pedagogical structure of the connectivist MOOC model (cMOOC) incorporates a social, distributed, networked approach

and significant learner autonomy that is geared towards adult lifelong learners interested in personal or professional development.

Later the MOOC concept was applied to postsecondary online education using the xMOOC model, which was designed as a traditional teacher-directed course, yet automated, massive, and online.

These two distinct MOOC models attract different audiences, use different learning approaches, and employ different teaching methods.

2. DESIGNING MODULE "PRESENCE AND ONLINE TUTORING" FOR THE MASSIVE OPEN ONLINE COURSE "ICT TOOLS FOR E-LEARNING"

2.1 Scenario of Designing MOOC "ICT Tools for E-Learning"

By the features and the outline of the course, the MOOC "ICT Tools for E-Learning" can be categorized as the one developed according to the xMOOC model which presupposes rather a linear course structure and more formalized evaluation of the learning outcomes.

In the context of the IRNet Project the designing the MOOC course was conducted to fit the following scheme:

- Course name;
- Defining course type (problem solving);
- Course target audience (defining learning communities);
- Short course summary (2-3 sentences);
- Developing course syllabus;
- Outlining the knowledge and skills out coming from the course completion;
- Students' qualifications as prerequisite and those which are aimed to be attained;
- Students' weekly schedule (hrs.);
- Course duration;
- Timing of the course;
- Teachers', guest lecturers' and experts' biographical notes (full credentials and photo if a lecturer has more than 30-40 min of video; short note and no photo otherwise);
- Grading chart.

2.2 Steps in the Process

In the process of designing the module a number of preliminary stages has been passed. In their overall logic they reflect the stages and principles of ADDIE model which entails generating the instructional design via analysis, design, development, implementation and evaluation [3].

In the process of our module development the steps include [3]:

1. Researching on the methodology of online tutoring [17].
2. Analyzing the experience of providing online tutoring in the context of the formal education at the higher institution in Turkey, collecting data on the teaching strategies from online tutors and analysis of the findings [15, 16].

3. Studying the methodology of MOOCs, research on the latest trends and tendencies in provision of MOOCs for different learning purposes [7].
4. Defining the mission of the module "Presence and Online Tutoring" within the MOOC "ICT Tools for E-Learning", outlining the scope of the aims and appropriate content.
5. Sharing responsibilities in the team for developing teaching materials within the subtopics.
6. Development and design of the content.
7. Adjusting the content to the conditions of the online teaching with the application of the appropriate ICT tools.

2.3 Teamwork in Designing the Module

For designing the module, its structure and content, together with its technological realization, the teamwork is of special importance. Following the overall project guidelines and requirements the interdisciplinary team was established to work mutually at designing the module and developing its content.

For the proper development of the content and its implementation via ICT tools the following competences of the developers in the team are of prime importance:

- scientific vision of the undergoing work;
- skills of coordination, delegation of the responsibilities, monitoring the work in progress, reviewing the teaching materials on their compliance with the teaching mission and aims;
- the expertise in the subject matter based on the knowledge of the recent trends in the area and practical experience;
- awareness of the range of ICT tools which: 1) can be applied for adjusting teaching materials to the conditions of online teaching, 2) would facilitate the process of the module design, 3) would channel interaction with learners;
- expertise in dealing with technical issues, i.e. establishing the platform for the MOOC, managing the platform, uploading the materials, etc.

2.4 Structure and Content of the Module

The overall architecture of the module reflects the scheme established as the common for all modules within the course.

It includes:

- Pre-test (diagnostic test);
- Core didactic materials;
- Package of tasks;
- Creative tasks block (Students Projects);
- Additional reference material;
- Knowledge control (Evaluation and assessment).

The content of the module was designed to reach the following aims:

- To define the methodology of online tutoring;
- To analyze different models and practices of online tutoring;

- To outline clusters of ICT tools applied for the purposes of online tutoring;
- To outline competences required for online tutors;
- To define the role and functions of social media in the context of online tutoring;
- To analyze practices of implementing social media in the context of online tutoring;
- To define learning activities aimed to provide interactivity in online tutoring;
- To describe specifics of assessment and evaluation in conductions of online tutoring.

To reflect the aims, the module consists of the following topics:

1. What is online tutoring?
2. Methodology of online tutoring.
3. Scenarios of conducting online tutoring.
4. ICT tools in online tutoring.
5. Social media in online tutoring.
6. Competences required for being an effective online tutor.
7. Interactivity in online tutoring.
8. Conducting assessment and evaluation in online tutoring.

2.5 Forms of Teaching Material Representation

The teaching materials were organized following the guidelines of the project coordination:

1) The lectures were video recorded in duration 5-7 minutes for each, total amount of the lecturing time per week is 45-60 minutes;
2) Video lectures are followed by the multi-choice questions for the learners to control their comprehension of the topic;
3) The block of lectures in the module is finalized with the summing-up assignments which are to be graded.

The overall scheme of the module representation is the following (Module "Presence and Online Tutoring" - one week):

- Video 2.1. What is online tutoring? + No grade multiple-choice test.
- Video 2.2. Methodology of online tutoring + No grade multiple-choice test.
- Video 2.3. Scenarios of conducting online tutoring + No grade multiple-choice test.
- Video 2.4. ICT tools in online tutoring + No grade multiple-choice test.
- Video 2.5. Social media in online tutoring + No grade multiple-choice test.
- Video 2.6. Competences required for being an effective online tutor + No grade multiple-choice test.
- Video 2.7. Interactivity in online tutoring + No grade multiple-choice test.
- Video 2.8. Conducting assessment and evaluation in online tutoring + No grade different task.
- Graded test.

2.6 ICT Tools Applied for designing the module

For the development of MOOC and namely the module under the discussion, the following ICT tools were applied:

- LMS platform - the virtual location of the course, allowing to upload and to manage the content of the modules with the provision of forum for the overall discussion;
- PowerPoint - for developing presentations on the topics;

- YouTube - as a source of open educational resources concerning online tutoring;
- Audio / Video recorders, video formatting ICT tools - for designing video lectures.

2.7 Problems Encountered

When facing the necessity to elaborate the module within the MOOC and during the process of its design many questions and problems were arisen and needed to be solved and answered.

In Table 1 the problems encountered are collected together and accompanied with the solutions which were taken to proceed with the work.

Stages in designing the module	**Problems and Questions**	**Answers and Solutions**
Establishment and initiating the work	1. Where to start from?	1. Analysis of the recent experiences in MOOCs, latest case studies and project findings brings the idea on the mission of the teaching within the module and MOOC as the whole.
Content of the module	1. What should be within the content of the module? 2. How deep and extended should the material be exposed, considering that the module should reach broad circles of learners who may have no or little idea of the subject matter? 3. What language (i.e. terms, professional jargon, complicated/simplified sentences etc.) should be used to deliver the content?	1 - 2 - 3. Due to the fact that the MOOC audience may not have specific knowledge on the course content, the layout of the lectures should be concise and subject focused. The language of the narration should be simplified in terms of the sentence structure and lexicon.

Stages in designing the module	Problems and Questions	Answers and Solutions
Structuring the module and its timing	1. Should the modules within the course be structured in the same way or according to the vision of the module designers? 2. How to structure the teaching materials with the reference to the time of learning (i.e. timing per week, the start and the end of the course as a whole)? 3. How long should be the online session? 4. What is the proper way and form of presenting the topic?	1. It was decided to establish the same framework for each module within the MOOC though the content designers are free in designing the lecture content and format they would like to choose for their lectures and assignments. 2. (2-3) Usually the material input per session does not last more than 10 minutes. Yet the format of representing the material together with the speed of the narration should vary to keep the viewers' attention. 3. (4) The mixture of the input with the follow-up discussions, tests and creative assignments was assumed to be a format of this MOOC. Although the framework may vary depending on the aims of the course and targeted audience.
Teaching methods	1. What is the purpose of the pre-test in the module? 2. What kind of tasks should be suggested as follow-ups to the topics within the module? 3. Should the topic be disclosed in a formal (lecturing) way or more informal i.e. via conversations, storytelling, bringing different voices and opinions, etc.?	1. The pre-test is purposed to: 1) obtain idea on the learners' background knowledge on the topic of the course, 2) to set the learners focus on the issues discussed in the course, 3) to use their responses to observe developments in the learners' ideas on the content. 2. In the framework of this module the assignments are of two types: 1) multiple-choice questions to check the comprehension of the topic, 2) creative or problem solving assignments aimed to bring learners to the implementation of the theoretical input into the practice i.e. to find solutions for the real situations using theories learnt within the course. 3. The video lecture in the module should be aimed to comply with the following rules: simplicity, topic-based, catching attention, emotionally appealing, involving story-telling, applying analogies, metaphors and case-studies where it is possible.

Stages in designing the module	Problems and Questions	Answers and Solutions
ICT tools for designing the teaching materials	1. What channels to use to establish synchronous and asynchronous communication with the learners and among them? 2. Which ICT tools to apply to design the content?	1. For this course LMS platform with options of forum is established for the learning and communication purposes. Synchronous and asynchronous communication can be realized via mailing and social media channel, i.e. Facebook, Twitter, etc. affordable for the learners. 2. As video and presentation formats remain to be the predominant ones, the ICT tools can be selected respectively. In the practice of this study PowerPoint, and Camtasia (for video formatting) were applied the most. Although other available ICT instruments with similar functions can be applied too.
Establishing and coordinating teamwork	1. How to establish teamwork and coordinate the project to achieve the aims?	1. It should be noted that designing MOOC requires interdisciplinary competences which include expertise in the content of the course, competences in instructional design and evaluation, knowledge and skills of ICT tools. Competences to find a solution how to convert traditional teaching, which under real conditions may range from lecturing to discussion and storytelling, to the virtual mode, are of great importance. They entail broad knowledge of emerging technologies, which can be used all together or substituting each other to facilitate the process of the course design and the online learning afterwards. 2. Coordination of the teamwork requires all members' understanding of their mission, clear-cut formulation of the aims, transparent delegation of the responsibilities and a rigid scheme of the deadlines for the work to be done.

Table 1. List of Questions, problems and solutions according the elaboration MOOC
Source: own

CONCLUSION

Based on the research conducted and the experience of designing the module for the MOOC course the following can be concluded:

1. Despite the existence of certain practices and research, MOOC as a pedagogical endeavor remains to be a novice for the majority of the educators and learners. Although, more and more institutions are joining the mainstream in their attempts to establish online learning and open MOOCs with an ambition: 1) to follow the modern trends in pedagogy, 2) make the institutions visible at the market of the learning services and 3) to reach broader communities of learners. Under these circumstances educators are facing a need to convert their teaching styles and methods to the mode of the virtual learning and, therefore, searching for appropriate solutions via applying ICT instruments.

2. Designing MOOCs requires a cohesive team work of experts possessing interdisciplinary competences including expertise in the content of the course, competences in instructional design and evaluation, knowledge and skills of ICT tools. Competences to find a solution how to convert traditional teaching, which under real conditions may range from lecturing to discussion and storytelling, to the virtual mode, are of great importance. They entail broad knowledge of emerging technologies, which can be used all together or substituting each other to facilitate the process of the course design and the online learning afterwards.

3. Considering high interest to the MOOC as a pedagogical phenomenon and attempts of instructors to join the mainstream in online education, this paper is believed to contribute to the development of the methodology of MOOCs and instructional design in online pedagogy. As the study presented in the paper is in its on-going process, the designers involved in the project continue to search for the proper solutions which will be observable after the implementation phase of the module and the course as a whole.

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MAPPING AND VISUALIZATION OF SCIENTIFIC BIBLIOMETRIC DOMAINS AND RESEARCH NETWORK ACTIVITIES

Eugenia Smyrnova-Trybulska
University of Silesia in Katowice, Faculty of Ethnology and Sciences of Education
Bielska 62, 43-400 Cieszyn, Poland, esmyrnova@us.edu.pl

Abstract: *The article focuses on trends and methods as well as tools used for mapping and visualization of scientific domains as a research methodology which is attracting more and more interest from scientific information and science studies professionals; several factors which have contributed to such developments are also discussed. Science mapping or bibliometric mapping is a spatial representation of how disciplines, fields, specialities, and individual documents or authors are related to one another [1]. Different approaches have been developed to extract networks using the selected units of analysis (authors, documents, journals, terms, etc.). Furthermore, the author looks at the most popular computer programs used for the processing of bibliographic and bibliometric data. In addition, plans and activities are presented concerning a comprehensive analysis of IRNet project networking activities and numerous publication, using special ICT tools and study methods.*

Keywords: networking, bibliographic and bibliometric data, webometrics, mapping, visualization, applications.

INTRODUCTION

Mapping and visualization of scientific domains as a research methodology is gaining more and more popularity among scientific information and science studies professionals. At least two factors have contributed to that. The first is the digitization of resources, scientific literature and other sources of knowledge, and hence, growth and development of bibliographic databases available online, such as ISI Web of Knowledge, Scopus, Google Scholar. The other is a non-linear increase in computing power, use of supercomputers and distributed technology ([2], [3], [4]).

Scientometric and bibliometric approaches are being increasingly used by some authors to assess the evolution and structure of scientific knowledge and R&D output (e.g., [5]; [6]; [7]; [8]; [9]). Normally, studies within this research field ([10]; [5]; [6]) aim to appraise the scientific output of individuals, journals and even organisations (e.g., effective publication in internationally refereed journals, high citation scores) by surveying and analyzing coauthorships and citation indexes.

At this stage of Web 2.0 development a popular trend has emerged whereby knowledge resources are mapped from the public web services. For example, a map of the English Wikipedia articles was generated using a measurement registering common categories of articles [11]. User activity specialist services also inspire analysis and mapping of data such as blogs and forums, users' logs [12] etc. The existing methods of information visualization have been successfully adapted in a network environment where websites with some approximation can be regarded as scientific articles, and hyperlinks as quote links. This approach has promoted the rapid development of Webometrics [3], [4].

According to [6], authors within this research field are interested in the increase of the interconnectedness of scientists (e.g., [13]; [14]; [15]; [16]; [17]), in figuring out patterns of collaboration in general (e.g., [18]; [19]; [20]; [7]; [9]) and of international linkages in particular (e.g., [21]; [22]), and further analysing implications of linkages for funding and outcomes (e.g. [23]; [24]; [25: 8-16]).

1. SCIENCE MAPPING

Science mapping or bibliometric mapping is a spatial representation of how disciplines, fields, specialities, and individual documents or authors are related to one another [1]. It is focused on monitoring a scientific field and delimiting research areas to determine its cognitive structure and its evolution [26]. There are different important aspects to a science mapping analysis, such as: (a) the data sources, (b) the units of analysis, (c) the data preprocessing, (d) the similarity measures that can be used to normalize the relations between the units of analysis, (e) the mapping steps, (f) the types of methods of analysis that can be employed, (g) some visualization techniques, and finally, (h) interpretation of results.

Different approaches have been developed to extract networks using the selected units of analysis (authors, documents, journals, and terms). *Co-word* analysis [27] uses the most important words or keywords of the documents to study the conceptual structure of a research field. *Co-author* analyzes authors and their affiliations to study the social structure and collaboration networks ([28]; [29]).

Finally, the cited references are used to analyze the intellectual base used by the research field or to analyze documents that cite the same references. In this sense, *bibliographic coupling* [30] analyzes citing documents, whereas *co-citation* analysis [31] studies cited documents. Other approaches such as author bibliographic coupling [32], author co-citation [33], journal bibliographic coupling ([34], [35]), and journal co-citation [36] are examples of macro analysis using aggregated data. ([37]: 1382)

1.1 Journal Citation Reports (JCR), Essential Science Indicators (ESI) and InCites

All of these products: Journal Citation Reports, Essential Science Indicators, InCites utilise Web of Science CC as their basis and they only collect and aggregate, from Web of Science, data originally provided by various "information units" (this refers to journals, scientists, institutions, countries etc.). Therefore, it is possible to collect citation statistics. For complex tasks it is not easy to do, so Web of Science CC is supported by analytical tools, and databases in particular.

JCR – database of bibliometric indicators for journals as a whole. Statistical data on the number of articles being published in journals, the number of references received by a given journal, distribution of references added / received references, the journal impact factor (see below para. 2.2.1).

ESI – database of bibliometric indicators, authors, organizations, countries, magazines. Statistical data on the number of articles published by an author / organization / country / journal and their citations (in ESI information on journals is less detailed than in JCR). In ESI limits are in place whereby only those organizations and authors are included who are in the top 1 % most cited ones in at least one scientific discipline; and only those logs and the

countries that rank in the top 50 % most cited in at least one scientific discipline. In addition, the ESI has a special section on global highly cited articles (which rank in the top 1 % most cited among those who come out in a given year in a given scientific discipline), average world bibliometric indicators ("baselines") and promising scientific "fronts", which are defined by a special citation procedure.

InCites – an analytical tool to carry out a detailed and thorough analysis of the bibliometric indicators of organizations, individual scientists, countries. This is the only product (tool) that utilizes citation normalization per field of science and per journal [38].

1.2 Review of mapping software

The following software products are used for processing of bibliographic and bibliometric data:

- *Bibexcel* (2009) – a software tool designed for many bibliometric uses by a Swedish scientist O. Perrson, the founder of BIN in Sweden. Acceptable data format – Dialogue (http://www8.umu.se/inforsk/Bibexcel).
- *CiteSpace, CiteSpace II* (2004) – an application created by Ch. Chen for various bibliometric analyses and visualization of results. Works with data formats downloaded from the Web of Science; database formats currently being developed include Scopus and Google Scolar, http://cluster.cis.drexel.edu/&u0007E;cchen/citespace.

Software for mapping and visualization:

- *CiteSpace*, – http://cluster.cis.drexel.edu/&u0007E;cchen/citespace, developed by Drexel University (USA) in 2010.
- *Pajek* – Slovenian free software, a program valued by professionals for the analysis and visualization of large data networks, http://viado.fmf.uni-lj.si/pub/networks/pajek/.
- *UCINET* – a program available in a trial version for the design and analysis of social networks in the world of science; preferred data matrix, http://www.analytictech.com/ucinet6/ucinet.htm.
- *XLSTAT* – commercial extension to MS Excel functions for statistical analysis and data visualization, http://www.xlstat.com/.
- *Permap* – a free, small item of software for mapping methods of multidimensional scaling; especially recommended for application areas of psychometric and sociometry, http://www.ucs.iouisiana.edu/~rbh8900/old%20web%20page.html.
- *VantagePoint* – developed by Search Technology, Inc in 2004.
- *HistCite* – is a large-scale computer tool for mapping science. Its power of visualization combines the production of historiographs on the basis of the analysis of co-citations of documents, with the use of specific bibliometric indicators [39].
- *Sci2 Tool* (2009) – The Science of Science (Sci2) Tool is a modular toolset specifically designed for the study of science. It supports the temporal, geospatial, topical, and network analysis and visualization of scholarly datasets at the micro (individual), meso (local), and macro (global) levels, (https://sci2.cns.iu.edu/user/index.php).
- *Leydesdorff's Software* (2004) – http://www.leydesdorff.net/software.htm.
- *Publish or Perish* – is a software program that retrieves and analyzes academic citations (http://www.harzing.com/resources/publish-or-perish).
- *VOSViewer* – http://www.vosviewer.com/, developed by Leiden University (The Netherlands) in 2010. An example of map visualisation of Academy of Management

Journal, executed in VOSViewer, is presented in Fig. 1.

Interdisciplinary research:

- *Network Workbench Tool* (2007) – The Network Workbench (NWB) Tool ([40]) is a network analysis, modeling, and visualization toolkit for physics, biomedical, and social science research.
- *IN-SPIRE* – developed by Pacific Northwest National Laboratory in 2010.

Applications used for typical statistical analysis of large data sets include *Statistica*, *Origin*, *Matlab*, *Mathematica*. In the list above, special note should be made of *CiteSpace* – a continuously developed complete tool supporting all stages of the visualization process from data extraction to validation of the resulting graphic configuration.

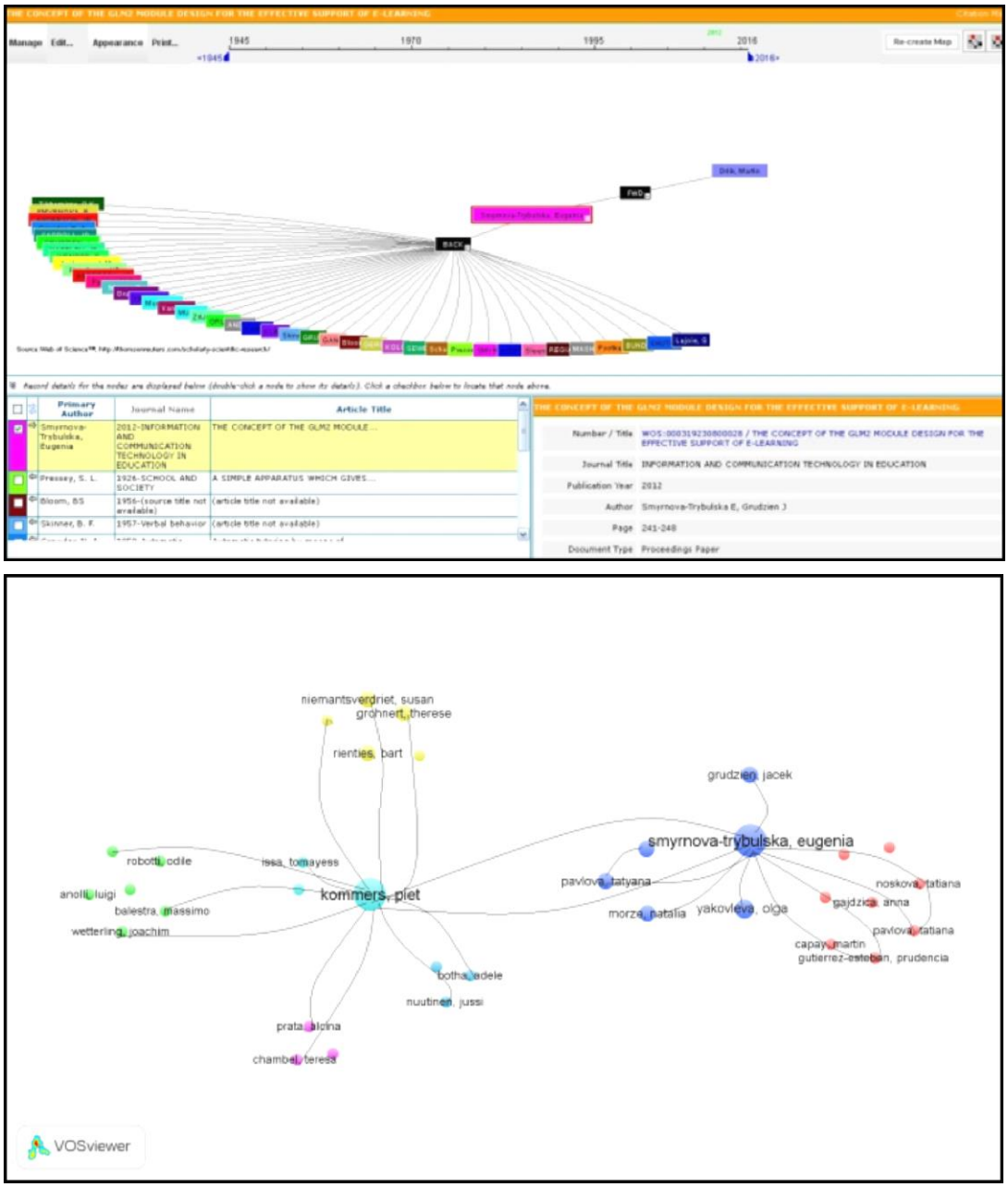

Fig. 1. Example of map visualisation in Web of Knowledge (up), and some articles relation of several IRNet authors, researchers prepared in VOSViewer (down)
Source: own

1.3 Mapping and Visualization of IRNet project Networking Activities

Within the framework of the IRNet project (www.irnet.us.edu.pl) research is being conducted in several WPs which are separate, yet simultaneously connected through interrelated stages, which roughly address our several research questions. We created a bibliographic database containing all the published articles, books from 2014 to date by all IRNet researchers (178 publications) (Table 1).

No	Names and Surnames	Afiliation	Title of Publication	Type (article, chapter, book, etc.)	Where was published (Conference Proceedings, Monograph, Journal, etc.)	Year	Key words	Indexing
1	Kommers P., Smyrnova-Trybulska E., Morze N., Noskova T., Pavlova T., Yakovleva O.	University of Twente University of Silesia, Poland Borys Grinchenko Kiev University Herzen State Pedagogical University	First outcomes of WP2 research carried out within the framework of the IRNet project - International Research Network	article	DIVAI 2014 – Distance Learning in Applied Informatics. Conference Proceedings, 5-7 May 2014. Editors: Milan Turčáni, Martin Drlík, Jozef Kapusta, Peter Švec, Constantine the Philosopher University in Nitra, p. 357-372, 654 p. ISBN 978-80-7478-497-2.	2014	E-learning. Legal, ethical, human, technical and social factors of /CT. IRNet - International Research Network Project	Web of Knowledge, Scopus
	....							
178								

Table 1. Bibliographic database of IRNet researchers
Source: own

This database also includes information regarding the number of authors, authors' affiliation, country, year, research areas, keywords, the source of publication (e.g., journal, book, etc.) and certain other data. Consequently, this dataset enables us to assess the main trends in IRNet scientific publications production. The time frame of the analysis is the last 4 years of IRNet existence, in which we have been able to trace its knowledge production and dissemination.

Based on the dynamics of international co-authorships, we will be able to map and trace international collaboration patterns and thus infer IRNet geographical influence scope, i.e., its international influence (Research Question).

By means of additional research utilising information available in the Institute for Scientific Information (ISI), namely in the Science Citation Index (SCI), we assess the geographical pattern of the citations of IRNet scientific activities, publications, production. This enables us to evaluate to what extent IRNet project scientific production has been cited at the European and world level.

CONCLUSION

This article presents trends, methods as well as tools used for the mapping and visualization of scientific domains as a research methodology which is gaining more and more popularity among scientific information and science studies professionals; furthermore, several factors contributing to this development are discussed.

In the market there is an extensive offering of various types of software for processing of bibliographic and bibliometric data; software for mapping and visualization as well as interdisciplinary research – open source as well as licensed programs.

The author of the article, a coordinator of the international IRNet project describes certain plans, methodologies and activities relating to comprehensive review of IRNet project networking activities and numerous publications, using special ICT tools and study methods; results of these activities will be presented in subsequent publications.

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Acknowledgement
The research leading to these results has received, within the framework of the IRNet project, funding from the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme FP7/2007-2013/ under REA grant agreement No: PIRSES-GA-2013-612536.

ENGLISH FOR THE ARMED FORCES OF THE CZECH REPUBLIC

Eva Staňková, Jana Beránková and Ivana Čechová
Language Centre, University of Defence
Kounicova 65, 662 10 Brno, Czech Republic
eva.stankova2@unob.cz, jana.berankova@unob.cz, ivana.cechova@unob.cz

Abstract: *Many members of the Czech Armed Forces struggle to cope with the Ministry of Defence requirements on their English language proficiency level. One cost-effective solution to help military personnel to improve their English is offered by a new e-learning course "English for the Armed Forces of the Czech Republic (ACR)", which was created by English language educators at the Language Centre at the University of Defence. Based on the theoretical principles of foreign language learning and practical implications of using ICT in this field, the paper discusses the lessons learnt from the process of development, implementation and evaluation of the course. The feedback obtained from the users poses many relevant questions which deserve attention.*

Keywords: ACR**,** blended/hybrid learning, course evaluation, distance learning, English language, e-learning, LMS Moodle, NATO STANAG 6001 examination.

INTRODUCTION

Universities all over the world offer a decreasing number of lessons, therefore regular face-to-face classes increasingly rely on the Internet to supplement the activities of teaching and learning, including support materials and other resources, providing information for students, or space for discussion between students and teachers or among students themselves. This combination of face-to-face classes with either synchronous or asynchronous communication via mobile media is known as blended or hybrid learning.

There are many definitions of blended learning or hybrid learning; however, it is necessary to avoid being too restrictive by setting stringent boundaries. Both terms are often used interchangeably. Kopecky [10] defines blended courses as those that "integrate online with traditional face-to-face class activities in a planned, pedagogically valuable manner" (Kopecky 2006, p.29). This means a teacher must implement modern technologies into classes, while wisely keeping timeless pedagogical values. According to Kamolbhan [9] "hybrid learning is designed to integrate the best features of regular face-to-face learning with technology-based online-learning by dichotomizing the total class time into a distance or a web-based learning portion and an in-class or face-to-face meeting portion" (Kamolbhan 2006, p.289). Garrison [8] states that "blended learning is the thoughtful fusion of face-to-face and online learning experiences" (Garrison, Vaughan 2008, p.7). Authors who have studied a wide range of materials finally decided on the following definition: blended/hybrid learning integrates online with traditional face-to-face class activities in a planned, pedagogically valuable manner. Cerna [5] mentions the role of blended learning for part-time students and self-study, and emphasizes that "e-courses are actively and systematically used as a source of study material, an information noticeboard and as a forum" (Cerna, 2016, p. 271).

Most foreign language educators would agree that blended learning is the best solution for improving their students' language skills [2, 3]. However, in the ACR not all the demands of

taking part in a face-to-face course can be satisfied. Therefore, other possibilities and solutions are being sought out, including distance learning.

1. ACR REQUIREMENTS FOR ENGLISH

Since English has become the NATO operational language, despite both English and French holding official status at NATO, English language teaching and testing have played a significant role not only for individual military members, but also for all NATO countries. To be effective when deployed together in operations and exercises, NATO countries are supposed not only to use the same technical standards but to speak the same language too. Furthermore, English language teaching and testing within the NATO countries have gained importance due to an increasing number of foreign missions and observations, participation in exercises, and postings to NATO multinational headquarters. Since STANAG 6001 does not enforce any criteria, nor standards in teaching, the military in each country has developed its own way of reaching the given language proficiency. All countries have developed centralized language education centers which provide military students with full-time courses in a given facility. However, the capacity of the courses is not sufficient, so on-line courses and mobile teaching are offered as one of possible solutions to gain the required level of STANAG examination.

Military professionals of the ACR are obliged to pass NATO STANAG 6001 exams in English in levels SLP 1, 2, 3, possibly 4 (SLP stands for Standardized Language Profile) according to the requirements of individual positions and ranks in the career structure. The UoD students are expected to pass STANAG SLP 2 in English in all four language skills (listening, speaking, reading and writing), which corresponds to B1 level according to the Common European Framework of Reference. It would seem that UoD students have better possibilities for acquiring the appropriate level of English thanks to their face-to-face lessons, but the number of their lessons is limited to 149 hours, which is not enough to pass STANAG SLP 2 exam in all skills. The usage of information technologies and blended learning strategies is one of the possible solutions to fulfilling these requirements.

Military professionals are provided with courses to pass STANAG exams. Before being able to attend such a course, applicants have to achieve a certain score in a placement test (American Language Course Placement Test - ALCPT). These placement tests are focused on receptive skills - listening and reading comprehension, including grammar and vocabulary, to support and enhance these skills for the required level. As a considerable amount of military professionals have had difficulties with their course admission, the Language Centre was tasked to tailor an e-learning course to provide them with a chance to practice the required skills and to pass the ALCPT test. Furthermore, the course is also intended to help University of Defence (UoD) students practice the required skills. To meet the ACR and UoD requirements, UoD teachers of English designed an e-learning course to supply military professionals, as well as students, with a variety of interactive exercises aimed at building vocabulary, and listening and reading comprehension, for their self-study.

2. ENGLISH FOR THE ARMED FORCES OF THE CZECH REPUBLIC (ACR)

LMS Moodle was chosen as the e-learning environment because it is most widely used at Czech universities and it offered us an extensive choice of interactive exercises which form

the core of the e-learning course. Another advantage is that Moodle is currently used at UoD as well as at Military Secondary School and College, so all military students are already familiar with it. Moreover, it seems reasonable to have a unified e-learning system for language education in the military. In addition to that, Moodle LMS offers the ability to cope with the heavy traffic of thousands of participants. As the e-learning course will serve for the whole ACR, it is possible that it will be used by 20,000 ACR employees (Cechova 2015, p. 117) [4]. LMS Moodle is also able to fulfill the expectations of interactivity and achievement tracking, since it offers a great variety of types of exercises with possibilities to add comments and explanations and to insert links and various types of recordings. However, Garrison and Kanuka [7] emphasize that "In order to teach a blended/hybrid course, instructors must devote their time and effort to redesign a traditional course and/or rethink the teaching and learning relationship" (Garrison & Kanuka 2004, p. 97). Together with searching for the suitable technological solution, the structure and content of the course were also being discussed, as the authors believe a good technological solution is just the framework for a balanced content.

The e-learning course consists of twelve topics which are suggested for the NATO STANAG 6001 SLP 2222 examination, because there is found the largest amount of unsuccessful ACR applicants for the preparatory courses. The topics are as follows:

1. Family and Relationships
2. Job and Career
3. Housing and Accommodation
4. Travelling
5. Shopping and Services
6. Leisure Time
7. Environment
8. Health
9. Food
10. Society
11. Media
12. Basic Military English.

Each topic includes authentic texts which were adapted by the teachers from the Language Centre of UoD and supplemented with a variety of activities, most of which are aimed at practising receptive language skills (reading and listening comprehension) at SLP 1+ - 2+. Some of the texts and activities were borrowed from the BRIDGE magazine with the kind permission of BRIDGE Publishing. Texts in British and American English are of different lengths to provide a range from easier to more difficult tasks. Moreover, a few non-interactive tasks with the key and activities are also included to stimulate productive skills (speaking and writing). Tests practising reading and listening comprehension skills without any relation to the individual topic form an integral part of the whole e-learning course.

The structure of each topic is as follows:

- Lesson 1: Texts and activities on the topic.
- Lesson 2: Listening comprehension test.
- Lesson 3: Texts and activities on the topic.
- Lesson 4: Reading and listening comprehension test.

The format of QUIZ in LMS Moodle was used for the presentation of e-learning materials because it enables users to receive feedback (Fig. 1), evaluation and record-keeping.

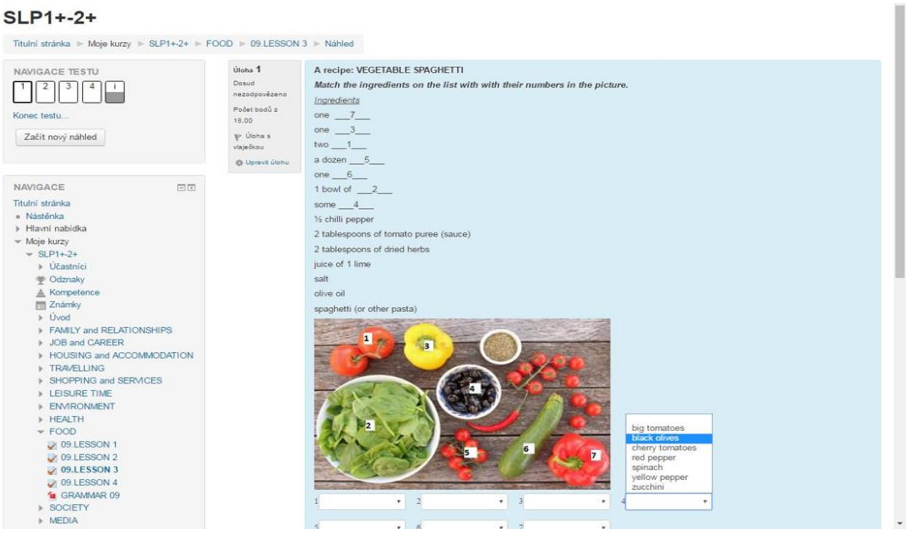

Fig. 1. Layout of the topic lesson
Source: own

Basically, we used the following types of interactive activities – multiple choice, close, true/false, drag and drop, and short answers boxes. When students finish the quiz, they submit it and their results are displayed as a percentage. They have a chance to look over their solutions and to compare them with the correct ones (Fig. 2). The number of attempts is not limited and the best quiz scores are recorded.

Fig. 2. Layout of the test with correct answers
Source: own

3. COURSE EVALUATION

Evaluation is an integral part of any educational program. Theoretical framework for language programs evaluation is discussed by Nuan [12]. He believes that "evaluations, incorporating questions, data, and interpretation, are a form of research" (Nuan 2004, p. 184). Based on his literature survey, he offers key questions to be considered for program evaluation, such as its purpose; principles of procedure; and appropriate tools, techniques and instruments.

The most common purpose of e-learning programs evaluation is to obtain useful, personalized and timely feedback which will contribute to the refinement of the course. Recent e-learning language studies show that learners' responses to questions and their additional comments and suggestions provide valuable impetus for further course improvement (e.g. Moscha et al. [11], Astratinei [1]). Our case study confirms this experience.

For the purpose of evaluating our course we decided to gather data by monitoring users' activities, and by administering questionnaires.

3.1 Monitoring the SLP 1+ - 2+ course activities

The aim of monitoring course activities was to find out to what extent the course had been used. LMS Moodle tools provide statistics, allowing us to check the course participants' attendance and their quiz results. The graph in Figure 3 shows the number of hits by guests (violet), students (orange), teachers (blue), managers (red), and the sum of all of them (beige) within a 9-month period.

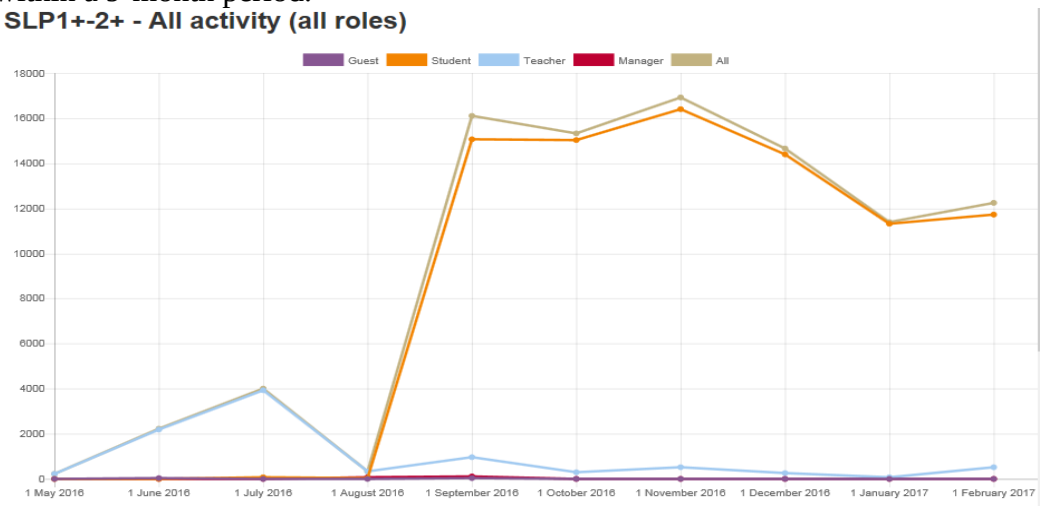

Fig. 3. Course activities from 1 May 2016 to 1 February generated in LMS Moodle
Source: own

As we can see, the period for course creation (blue line) was relatively short (from May to August 2016, including mandatory summer leave). At the end of August the military professionals, selected by personnel departments at their military units, attended the pre-course briefing and signed up as students (orange line) for the course. They were followed by UoD students later in autumn. The number of hits by students remained relatively stable from the beginning of September to the end of November (around 15,000 hits per month). After this there was a slight drop in the period of Christmas and New Year holidays in December, and since then the number of hits has not increased much. Overall, the attendance shows that the course has been frequently used.

More detailed information about the attendance of particular parts of the course, as well as personalized participants results, can be obtained from Moodle protocols. The protocols of student activities show that whereas a handful of the most diligent military professionals have almost finished all the activities in the course, some students have not accessed the course at all except for the pre-course briefing. So the student virtual attendance rate differs from one student to another.

3.2 Feedback from military professionals

The feedback from military professionals, the primary target group, was obtained by two different electronic questionnaires. In January 2017 we divided them into 2 groups according to the data in activity protocols in Moodle. Group 1 included military professionals in the role of students who did not submit any results (35 users). Group 2 was represented by military professionals who accessed the course after the pre-course briefing and submitted some auto-test results (146 users). Each group received a different electronic questionnaire. Both questionnaires were created in Google Forms, which allows the creators to view responses in spreadsheets or in summary graphs.

The aim of the questionnaire prepared for Group 1 was to obtain information about what discouraged them from using the course. We received answers from 13 respondents. Most of them are at beginner (44.4 %) or pre-intermediate (33.3 %) levels of English language proficiency. The three most frequently stated reasons for not participating in the course were as follows:

- I use different resources for my English language study. (63.6 %)
- I don't have time to use the course. (54.5 %)
- The exercises are too difficult for me. (45.5 %)

As to the language skills which they needed to improve, they selected listening (69.2 %), vocabulary (61.5 %), and speaking (53.8 %). Some of them would like to take a course for beginners aimed at reaching SLP 1111.

The aim of the questionnaire designed for Group 2 was to get detailed feedback on the course. We wanted to find out whether the course served its purpose, what was working well and what was not, and what problems needed to be addressed. The responses from 93 users have provided valuable feedback with numerous impetuses for further course improvement.

The statistics of the responses show that most of the respondents are at beginner (48.8 %) and pre-intermediate (35.5 %) levels of English language proficiency. Hence 46.7 % of respondents stated that the exercises in the course were too difficult for them. This situation is frustrating for both the users and us, the course creators, though we have anticipated this problem since the pre-course briefing.

Some questionnaire items focus on the respondents' reflection on their language skills development when using the course. We are pleased to learn that they believe that the course has positively influenced their vocabulary, reading and listening skills. Obviously, speaking skills are on the other end of the scale. Since the course does not aspire to improve speaking skills, it was not surprising to find out that up to 53.8 % respondents stated that the course had not influenced their speaking skills at all. On the contrary, it sounds encouraging that the remaining 46.2 % respondents admit that the course has influenced their speaking to a certain extend. Some of them suggested solutions for improving their speaking, such as participating in an intensive English language course, or getting some support for attending a language school, or being taught English at their workplace.

In addition to the above, the feedback provided numerous proposals for course improvement. Table 1 summarizes in brief some comments from users, and the reactions to them from course creators.

Comments from users	Reaction from course creators
The course is too difficult.	Links to courses for beginners were sent out.
Lack of tutoring.	Forum was created in the course.
Some errors in the course.	Correction of errors. Thread for recording errors in the forum.
E-learning is not for me.	Pros and cons of E-learning.
Feedback after lessons is too delayed.	Feedback after each exercise is being tested.
Technical problems.	Moodle update explained; measures taken.

Table 1. Comments from users and actions taken by course creators
Source: own

The respondents were also asked to grade some practical aspects of the course with marks on a scale from 1 to 5. The average grade for LMS MOODLE was 2.2, for the selection of topics 2.1, for the quality of language exercises 2.4, for the quality of feedback 2.4, and the whole course achieved grade 2.5.

All respondents from Group 2 received a general reaction to their responses by e-mail. The purpose of this feedback on feedback was twofold: to encourage them in their English language study and to invite them to collaborate on the improvement of the course.

SUMMARY AND FURTHER RESEARCH

Since the Czech Republic joined NATO in 1997, the educators have been searching for ways of assisting military personnel in their English language acquisition. With the introduction of multimedia, blended learning has become the most powerful form of study. If well designed, it addresses more learning style requirements, a wider audience and increased performance or learning results. Nevertheless, for various reasons, many ACR professionals do not have a chance to participate in a blended learning course, and are assigned to enhance their language skills by distance learning assisted by a recently designed course "English for the ACR". Presently, the course is being used for distance learning and self-study by military professionals, and for blended learning by UoD students.

The paper focuses mainly on the evaluation of this pilot course based on Moodle statistics and feedback from military professionals who use the course as distance learning support. The most disappointing finding obtained from the feedback is that almost half of the group of military professionals who were selected to do the course by human resources officers were not in the correct target group for participating in the course. The questionnaire results demonstrate that applying a blanket solution to such a large group with different language needs proves to be unsuccessful. On the other hand, users with the appropriate level of English language who are determined to develop their language skills consider the course useful and express their gratitude, though they emphasize that face-to-face instruction is irreplaceable. Further information collected in the questionnaire survey was used to address problems that have been identified, and to improve the content and delivery of the course. Thus the course is being constantly improved and adjusted to learners' needs.

An important result of the evaluation of this pilot course is a set of new questions which can be used as ideas for further research. One target for additional research might be a selection procedure of potential candidates; for instance, by assessing their level of English language proficiency prior to their participation in the course. Further research could be conducted to

determine a method of measuring to what extent the course contributes to the improvement of users' language skills. For example, entrance and final proficiency tests could be designed and implemented in the course; or the difference in the results of the ALCPT tests taken before and after the course could serve as indicators of user's progress. To conclude, the evaluation of the course has unearthed numerous questions and added fresh impetus to further research in distance and blended language learning.

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Acknowledgement

The work presented in this paper has been supported by the project "Language Training Development in the Defence Sector" within the "Long-term Development Plans of the Organization" (DZRO in Czech).

VIRTUAL REALITY AND ITS ROLE IN EDUCATION

Ľubica Stuchlíková
Slovak University of Technology in Bratislava, Faculty of Electrical Engineering
and Information Technology, Institute of Electronics and Photonics
Ilkovičova 3, 812 19 Bratislava, Slovakia, lubica.stuchlikova@stuba.sk

Abstract: *In recent years, virtual reality has become more common through a range of systems including computer peripherals, computer-powered head-mounted displays and smartphone-powered headsets. In this article the virtual reality and virtual world potential to change and improve the higher education in many fields is explored. The focus is on some opportunities and challenges of implementation of virtual reality training systems using self-adaptive technology in wide area of academic education.*

Keywords: Virtual Reality (VR), Virtual World, online education, self-adaptive technology.

INTRODUCTION

In recent years, there has been a growing interest in the use of 3D environments such as virtual reality (VR) training systems and virtual worlds in education. Compared to the traditional two-dimensional web environments, a 3D environment adds a spatial dimension. This additional dimension enables the users to perceive depth which is crucial in e.g. practical demonstrations [1]. VR education solutions empower students by directly engaging with their subject topic through immersive interactive experiences. The VR method gives opportunity to hinder memorization from the learning process. By transiting from the traditional approach, students are given the ability to apply, analyze and evaluate their knowledge, improving their creativity, critical thinking, problem solving, decision-making, communication and teamwork. Many universities go to great lengths to develop e-learning systems with up-to date technologies that may provide students the most comfortable, engaging and involving learning environment. One of their key aim is to design learning environments that support the student's active involvement in the formation of their own understanding. This can be accomplished e.g. by implementing of the basic principles of adaptive and collaborative learning. Adaptive learning uses computers as interactive teaching devices, and to orchestrate the allocation of human and mediated resources according to the unique needs of each learner [2, 3]. The crucial element of collaboration learning is social interaction [4]. One of the challenges in online education is therefore to make ideal environment for the student-student interaction similar to traditional campus education. VR in which the users are visually represented as avatars that are able to move around 3D environment give us this desirable opportunity. This paper introduces some opportunities and challenges of VR and virtual world in academic education from author's point of view.

1. VIRTUAL REALITY

"Virtual reality is the term used to describe a three-dimensional, computer generated environment which can be explored and interacted with by a person. That person becomes part of this virtual world or is immersed within this environment and whilst there, is able to manipulate objects or perform a series of actions" [5]. The concept of VR is not new; the

technology behind it has been developing for several decades - examples include stereoscopic projectors from the nineteenth century to the flight simulators which first “Link trainer” (was entirely electromechanical) appeared in the 1930s. The modern history of VR begins rather crudely with the Sensorama, which was patented by Morton Heilig in 1962 [6]. The term "virtual reality" was coined by Jaron Lanier in 1987 during a period of intensive research activity of this technology form. Before this action (in 1984), he set up VPL (Visual Programming Language) Research – a company which pioneered research into VR and 3D graphics and sold the first VR gear such as VR glasses, data gloves and later, complete data suit [5]. A major cultural impact which brought the topic of VR into the mainstream had been evoked by the film “The Matrix” introduced in 1999. VR became very popular around this time, but this soon dropped off due to a yawning gap between public expectations and technological limitations. VR has been hovering on the periphery of technology without achieving accepted mainstream application or commercial adoption.

Nowadays the VR technology is dynamically developed, thanks to appearance of low-cost devices and interest by large companies related to entertainment, communication and visualization [7]. The rise of smartphones with high-density displays and 3D graphics capabilities has enabled a generation of lightweight and practical VR devices. Depth sensing cameras sensor suites, motion controllers and natural human interfaces are already a part of daily human computing tasks. Current domestic VR technology tends to fall into one of three trends: Computer Peripherals, Self-contained Headsets and Smartphone-based Headsets. Companies like Google have released interim VR products such as the Google Cardboard (2014), a DIY headset that uses a smartphone to drive it. This Cardboard brings immersive experiences with VR on smartphone to everyone in a simple, fun and affordable way. In 2014 also Facebook acquired Oculus Rift1 (VR headset company) for $2 billion. Companies like Samsung have taken this concept further with products such as the Galaxy Gear, which is being mass produced and contains “smart” features such as gesture control. In 2015 YooTube introduced uploading of 360° video. Facebook builds a VR empire: built 22,000 square-foot hardware lab in 2016. This is a prototype development lab for solar drones, Internet-beaming lasers, VR headsets, augmented reality devices and next-gen servers. Google released Omnitone, open source 3D audio for web-based VR and launched the Daydream platform for high-quality mobile VR. The year of 2016 was a breakthrough one for VR. Big-name hardware like the Oculus Rift, HTC Vive and PlayStation VR all hit the marketplace, bringing with them a flood of content and clever implementations that had made early adopters promote the exciting new technology. The Oculus Rift and HTC Vive headsets pack have dual OLED displays with a resolution of 1,080×1,200 per eye, both have a 90 Hz refresh rate and 110-degree field of view, and both need very similar PC requirements to run. Besides the 37 sensors in the Vive headset that provide fluid, seamless movement, there's also a front-facing camera that can make a virtual world of difference. HTC's camera allows Chaperone safety system to cast a blue outline on walls and objects when you get too close. You can even turn it on for a Matrix-like look on everything at once [8]. But the current generation of hardware has connected the user to a powerful PC via annoying cables. It is excited to be freed from cables in 2017 - the companies, such as HTC, are working on wireless headsets.

VR start-ups have raised more than $1.46 billion in venture capital, including more than $100 million in funding during the last four consecutive quarters. According to Citi analyst Kota Ezawa, 2016 is the year in which VR will take off in black numbers for a first time, with the VR market expected to grow to a $15.9 billion industry by 2019 [9]. Citi also anticipates the market for hardware, networks, software and content will reach $200 billion by 2020 [9]. The

User Base explodes. The people are ready for VR, and 2017 will witness a massive jump in user numbers. From around 200,000 in 2014 to a projected 90 million in 2017, this represents a 450% increase. Around 10% of the 90 million users in 2017 will be “hardcore gamers”, while a further 23 million will be categorised as “early adopters” [10]. This suggests that the next 12 months will present the ideal opportunity to put new VR application into the hands of an engaged and motivated audience.

1.1 Virtual Reality in Education

The VR applications, starting from a level of simple graphic applications made for entertainment and studies are now used extensively in many professional branches [11]. An important area of application for VR systems has always been training for real-life activities, job training or new ways of introducing an audience to a concept or experience. The attractiveness of simulations is that they can provide training equal or nearly equal to practice with real systems, but at reduced cost and with greater safety. VR can be used when learner mistakes in reality could be devastating and/or demoralizing to the learner, harmful to the environment, capable of causing unintended property damage, wasteful of materials... [7]. These results are important reasons to use VR in education. They include fact that it provides motivation; can more accurately illustrate some features, processes, etc., than by other means, allows extreme close-up examination of an object; allows examination of an object from a distance, showing the whole rather than a part; allows the disabled to participate in an experiment or learning environment when they cannot do so otherwise; gives the opportunity for insights based on new perspectives age, allows a learner to proceed through an experience at his/her own pace, too time consuming [1, 12].

Since the early 1980s, the military and law enforcement sectors have actively researched, developed and implemented VR to train members of the armed forces to fight effectively in combat. In 2014, the British government made the announcement that it would incorporate Oculus Rift VR headset into its training for medical emergencies on the battlefield. Other military uses are e.g. simulations that can help train how to deal with improvised explosive devices — simulations like those can be repeated and mistakes made in those can be learned from [11]. Astronauts and jet pilots use simulators and VR gear such as head-mounted displays to learn how to navigate, fly, and react to unexpected situations, before they actually fly a space shuttle or jet aircraft [7]. One recent use is dedicated to improving the quality of life and mental health of astronauts on longer term missions. Techniques and equipment developed by NASA and the military establishment are being introduced to non-space-related and non-military applications.

VR training and assessment is more frequently used for five key areas: medical, industrial & commercial training, serious games, rehabilitation and remote training such as Massive Open Online Courses. Adaptation can be applied to five core technologies of VR including haptic devices, stereo graphics, adaptive content, assessment and autonomous agents. Automation of VR training can contribute to automation of actual procedures including remote and robotic assisted surgery which reduces injury and improves accuracy of the procedure. Automated haptic interaction can enable tele-presence and virtual artefact tactile interaction from either remote or simulated environments. Automation, machine learning and data driven features play an important role in providing trainee-specific individual adaptive training content.

VR has multiple applications for healthcare. Well known application is "Virtual Patient" (VP), e.g. a shared online bank of 320 virtual patients "eViP" [13]. The primary form of VPs

is dealing with interactive patient scenarios, but popular forms are also case presentations, VP games, high fidelity software simulation [14], virtual standardized patient [15]. Rapid technical advances that would nowadays support more complex applications open new challenges for VP. The interactions with VPs are associated with improved learning outcomes related to nontechnical skills in particular, communication, teamwork, and decision-making. The findings suggest that the VP method is applicable to various disciplines and may play a significant role in preparing students for practice and development of individual schema enabling transfer of learning of nontechnical skills to new situations. Learning nontechnical skills from interactions with VPs may require consideration of the educational design of the simulation experience, the sequencing of learning activities surrounding the VP, and the challenges faced in representing the unstructured, unpredictable nature of the clinical environment in a simulation setting [16]. One of the frequently mentioned uses of VR is treatment of psychological conditions, such as phobias and anxieties, by means of exposure, which is known as the Virtual Reality Exposure Therapy [17]. There are many cases of successful use of such therapeutic tools as treatment of acrophobia or post-traumatic stress disorder. For example, psychiatrists at the University of Louisville use VR in cognitive behaviour therapy to treat patients with social anxieties or phobias of things like flying, public speaking, or heights. The controlled environment allows doctors to expose their patients to simulations and direct them on how to cope with how they're feeling.

Worldwide, VR is used for everyday training hand-eye coordination and physical skills. Training with VR has been applied to many training disciplines including flight simulation, military, engineering, space, automotive sport, and manufacturing. Training will be a major use for VR — there's potential for everyone. For younger students though, VR in the classroom could mean virtual field trips, immersive games, and even uses for children with special needs. Today VR-based learning has centered on the hard sciences (biology, anatomy, geology, geography and astronomy) as the curricular focus and learning opportunities are notably enriched through interaction with dimensional objects, animals and environments [9]. VR tools are used to collaboratively construct architectural models, engineering models, recreations of historic or natural sites and other spatial renderings. For example Google Earth VR was released for the HTC Vive in 2016 and it is one of the most promising applications of VR for geography education which explores the world from totally new perspectives in VR. The advantage of VR tools use is that it enables large groups of students to interact with each other as well as within a three dimensional environment – Virtual World.

1.1.1 Virtual World

“Virtual worlds are persistent virtual environments in which people experience others as being there together - and where they can interact with each other” [18]. Virtual worlds are richly immersive and highly scalable 3D environments, where people enter via an avatar which is their representation in that space, moving their avatar through the space as if they were physically walking, or in some cases even flying [19]. The most popular virtual worlds are multi-user spaces, meaning that many people can be in the same virtual space and interact with one another in real time. The most important finding from many studies (e.g. [1]) is that the virtual world provides enhanced interactivity because it serves synchronous communication and places the student in a spatial dimension. In order to make full use of this enhanced interactivity, the users’ technical skills must be improved and the technical problems associated with computer-generated environments must be resolved.

Virtual worlds have been an important place in people's lives over years, in addition to the real world where we physically live. For example, authors in [20] reported that millions of people from different areas of the world spent an average of 22 hours a week in virtual worlds to interact with others via their avatars. There are several types of other virtual worlds which include: Second Life, The Sims, Active Worlds, Kaneva, IMVU, etc. In a more recent study, [21] mentioned that Second Life (SL), one of the most popular virtual worlds, had a million users each month, with 30,000 to 50,000 users logged in simultaneously [22]. SL is an online virtual environment launched in 2003, developed by Linden Labs. It is a 3D simulation of the real world, with buildings, islands, oceans, etc. Almost everything that can be found in the real world has its equivalent in the SL. Users of the SL, called Residents, can interact with each other through avatars. Residents can explore the virtual world, meet and socialize with other Residents, and participate in numerous activities. SL also allows users to create content (for example they can even create and trade virtual properties and services with each other). What we see today in the SL is mainly created by the users. SL has its own currency, the Linden dollar, convertible into the real US dollar. Users can enter SL for free, but if they wish to buy virtual articles, they have to pay real money. So, in many ways, SL functions like a nation, having its own economic and social structure. Since Second Life was launched, the number of Residents has grown to more than 37 million registered users.

The virtual world includes not only the virtual campus, but also a various activities, experiences and interactions that are a part of the virtual world. In order to make full use of this enhanced interactivity, the technical challenges must be dealt with and the users' technical skills need to be further developed [12]. In addition to this, in case where the virtual world is used, it gives a new experience for students, the virtual world per se constitutes a collaborative learning activity that contributes to socialisation between students. An important aspect to consider is how the students' technical skills may affect this interaction and the teacher must be aware of the fact that the students need to become well acquainted with the virtual world before it is possible for them to focus on the actual course content. As more and more students get acquainted with virtual world environments, new rules for social interaction emerge. When students start getting used to interacting through avatars, we will be able to see the true potential of interaction in these settings. The findings from some studies also point to the conclusion that, in this case, a virtual world is currently not adequate as a learning environment on its own. There is a need to construct an additional information space in order to gather all information regarding the course and to display this information outside the rather distracting, graphically rich and socially dynamic virtual environment [1].

What is the difference between a virtual world, and VR? Very impressive answer is presented in [23] "A virtual world is a fake place you can visit. VR is an immersive way of experiencing virtual worlds". VR is more than just virtual worlds with extra immersion. David Burden [24] introduced five 5 key differences between virtual worlds and VR:

- the 3D effect is natural; the user actually is inside that avatar, inside the virtual world,
- forced first person view; any unnatural camera movement not only destroys immersion, but increases vertigo and could make users nauseous,
- no distractions; with a traditional viewer, a virtual world is only a click away; while wearing a VR headset, you cant look away, or have the physical world distract you,
- isolation; you feel as though it's just you and the virtual world and
- vulnerability; it's just you and the virtual space.

1.2 Virtual Reality risks

It is important not to forget that with above mentioned great VR opportunities there always come some disadvantages, dangers and risks. There had emerged stress or anxiety between people after use of in many occasions [25]. There are more of these as eyestrain, nausea or motion sickness. Last but not least we cannot forget maybe the biggest danger – loss of contact with real world. We have to learn from current situation - even though our technology is still limiting us, this problem appeared with social media or with normal video games.

1.3 Virtual Reality - summary

Virtual Patient and Second Life at The University of Edinburgh Medical School and Dundee University in 2009 were my first contacts with VR in education. I, as a teacher, designer and developer of e-learning projects [26] with many years of experience, was fascinated by the idea and also technologies. Concurrently, more than 50 million pounds were invested in project VP, which is incomparable with the financial conditions in Slovak education.

But nowadays gap between public expectations and technological limitations of VR decreases. 3D visualisation is used extensively in research and industry. VR and virtual world are gradually becoming an essential part of modern academic education and/or a viable alternative to traditional campus education due to the rapid development of information technology and VR hardware/gear. Actually in December 2016 the first VR classroom ("Human Anatomy VR") was established in Faculty of Medicine of Comenius University in Bratislava in partnership with Slovak University of Technology [27]. The massive entry of the VR in the field of entertainment will prepare youth for working with VR technologies [28]. We can easily introduce VR in higher education, because our target groups will already be prepared. Future trends will bring VR applications to support every engineering education program. A virtual classroom setting opens up the playing field for high-demand courses, allowing schools to accept more students, and providing candidates with more learning opportunities. In my opinion visualization is essential in the learning process. VR has a major role to play in engineering education in the future. VR will change the way of education and training. Engineering education will benefit from it. Very important in our technological society is implementation of VR as one of several forms of technology enable us to educate tomorrow‘s technological elite.

CONCLUSION

Development of the new low-cost devices (started by the Oculus Rift DK1 device), as well as growing interest of large electronic entertainment companies (such as Samsung, Microsoft, Facebook, etc.) leads to increase of availability and popularity of VR technology. This leads into using VR and virtual world in various disciplines, for example in higher education, where potential is large, but its use was so far scarcer. The rising acceptance of VR in the e-learning field creates new challenges such as implementation of self-adaptive technologies within VR training and/or producing student-centred courses, that can be automatically customized for individual student's needs. Thanks to the sensors and experiential of VR, learners of all three modalities – kinaesthetic, visual, and auditory – benefit from VR education and achieve faster learning while developing higher level of cognitive skills. VR education solutions empower students to learn-by-doing by directly engaging with their subject matter through immersive interactive experiences. Learning transitions from traditional memorization is giving students

the ability to apply, analyse and evaluate their knowledge by improving creativity, critical thinking, problem solving, and communication. VR training based solution using self-adaptive technologies help students learn faster, remember longer, and decide better.

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Acknowledgement
The work presented in this paper has been supported by the agency KEGA the Ministry of Education, Science, Research and Sport of the Slovak Republic for under Grant 020STU-4/2015.

ANATOMY ATLAS DESIGN USING MOBILE PLATFORMS AND VIRTUAL REALITY

Miloš Svrček[1, 2], Tomáš Brngál[2] and Erik Vavrinský[1, 2]
[1]Slovak University of Technology in Bratislava, Faculty of Electrical Engineering and Information Technology, Institute of Electronics and Photonics
Ilkovičova 3, 812 19 Bratislava, Slovakia
[2]Virtual Medicine, s.r.o., Digital Park II, Einsteinova 25, 851 01 Bratislava, Slovakia
xsvrcekm2@stuba.sk, erik.vavrinsky@stuba.sk

Abstract: *This paper deals with design of a Virtual Reality (VR) application labelled "HUMAN ANATOMY VR" which is used for displays of an anatomy atlas. The attention is focused on its benefits in learning activities and practice for medical students and practitioners. This application is designed using mobile platforms to maintain better imagination, easier orientation and higher degree of interactivity. In comparison with classic anatomy atlases, this approach is a unique project ensuring suitability for mobile platforms with all its complex and demanding anatomic models.*

Keywords: Virtual Reality (VR), anatomy, advantages of VR learning, mobile platform.

INTRODUCTION

The term virtual reality (VR) is becoming a common knowledge. According to [1] virtual reality is a computer-based environment that replicates real world or adjusts it for different purposes. It is used not only for entertainment, but also in professional areas, such as medicine [2], education and various simulations.

Connection of technology and education makes learning easier. Students today use e-learning, online courses, instruction videos, but also virtual reality. First attempts to use VR in education are dated back to the 90‘s. The first school that took interest in simulation was *Brazilian medical school*. Later, in 2009, *School of Medicine da Universidade de Sao Paulo* and *FMUSP* started to train various medical techniques in virtual reality [3]. However, the technology was unaffordable for common people. First affordable VR headset designed for developers (Oculus Rift) was released in 2012. At the end of 2015 new VR headsets were available for commercial purposes. First educational VR applications appeared in the same year. Nowadays, there are some schools already using VR technology. There are mainly high schools and universities that specialize on technology and architecture [4], e.g. *Stanford University* or *Western University of Health Sciences* in Pomona, California. Second mentioned uses VR learning in study programmes like dentistry, osteopathic medicine, veterinary medicine, physical therapy, and nursing [5].

The first universities in Slovakia that started to use VR learning were *Slovak Technical University* (FIIT, FEI) and *Comenius University* (MF). On 6 December 2016 we participated in setting up VR classroom at the Comenius University [6]. Medical students can use our application "*Human Anatomy VR"* in this classroom (Fig. 1). This application became the first anatomy VR application for mobile platforms.

Fig. 1. VR Anatomy classroom at the Comenius University
Source: [7]

The aim of this paper is introduce author's experiences with design of the first anatomy virtual reality application for mobile platform in Slovakia.

1. VIRTUAL REALITY EDUCATION

VR has great employment possibilities in education and it can make learning easier. Edgar Dale's [8] scheme shows that people are statistically able to remember 10 % of what they heard, 20 % of what they read and 90 % of what they did or simulated.

According to this model, students are able to remember 90 % of information with the help of VR. This is a great advantage for university students. Virtual reality can be very effective tool in the education of medical students. The main problems in anatomy learning are poorly arranged anatomy atlases, bad legibility and imagination. For instance a picture of wrist from both sides below is shown on Fig. 2 [9].

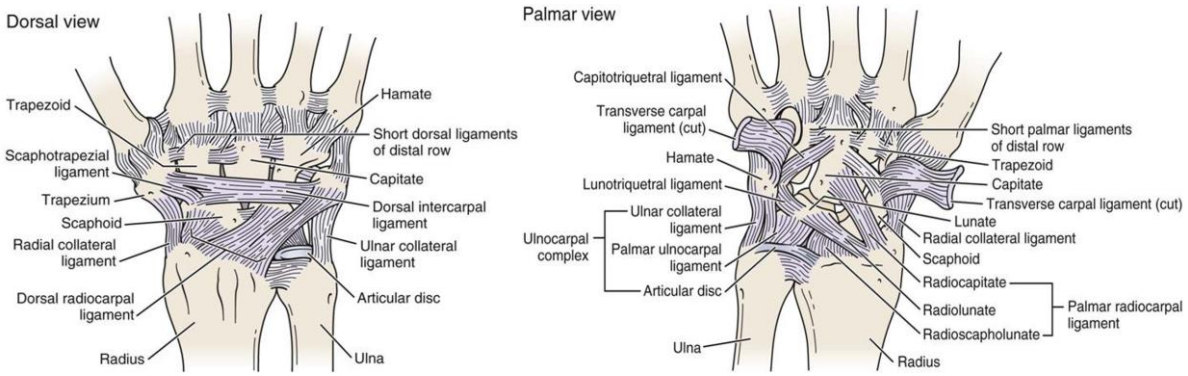

Fig. 2. Anatomy of wrist
Source: [9]

For laymen or medical students – beginners it is very hard to orientate in these structures. Next problem is to get to the dissection during studying.

We connected virtual reality and anatomy learning and created a unique immersive application for easier and more effective anatomy learning. The proposed application can be used repeatedly.

2. APPLICATION "HUMAN ANATOMY VR"

We developed the application named "HUMAN ANATOMY VR" for *Samsung Gear VR*, which is a virtual reality headset that works with *Samsung S6/S7* smartphones (also *Edge* versions) [10]. We have chosen this specific headset, because it is simple, mobile and students can use it everywhere. *Samsung Gear VR* offers high-end mobile virtual reality, so we can display anatomy models in high quality. Supported smartphones [11] use high resolution 2560 × 1440 with 577 PPI. The headset contains three control buttons on the body (back, home and touchpad). Touchpad on the right side interacts with anatomy structures and user interface. The application was developed in graphic engine *Unity 3D* [12] using programming language *C Sharp*. Since anatomy models are heavy on performance, we decided for engine that offers higher optimization. Fig. 3 depicts *Samsung Gear VR*.

Fig. 3. Headset Samsung Gear VR
Source: own

The application *Human Anatomy VR* contains all necessary functions for anatomy learning. The application is made in two language versions – English and Latin. *Human Anatomy VR* contains detailed descriptions of anatomy structures, which makes it a great anatomy book. In comparison with classic anatomy atlas, user can intuitively rotate, add and zoom specific anatomy structures. Fig. 4 depicts the main image of skeleton in the application. We decided for space motive of surroundings, because it is imposing and pleasing at the same time. One of the most important functions is *Multipick* – user can select more bones simultaneously and compare their descriptions and anatomy. Function *Search* enables user to find certain bone quickly. Students can test obtained knowledge in two different versions of test (e.g. model of CT scans). On the Fig. 5 is depicted *Test Choose*, where user decides for one of 6 possible answers. The aim is to make anatomy learning more effective and entertaining.

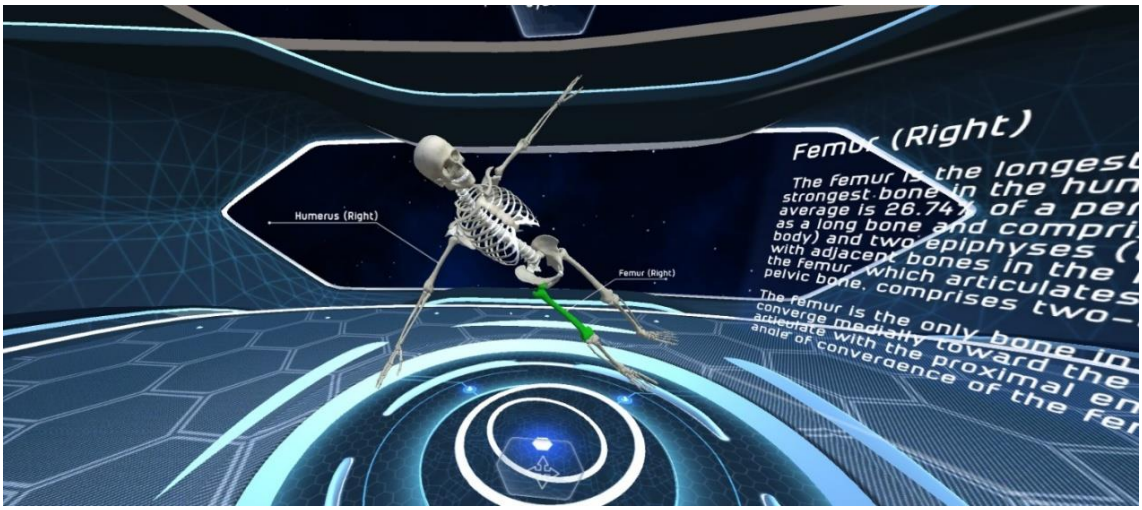

Fig. 4. *Human Anatomy VR* application, learning environment
Source: own

Fig. 5. *Human Anatomy VR* application, test *Choose* enabled
Source: own

CONCLUSION

We developed application *Human Anatomy VR* for *Samsung Gear VR* headset in 3D Engine Unity. It contains all functions necessary for anatomy learning, such as rotation, enlargement and addition of new anatomy structures. Application is bilingual with English and Latin nomenclature. It contains tests, where students can verify obtained knowledge. Next step in our research is to see how our application works in practice. We established first VR classroom in Faculty of Medicine of Comenius University in Bratislava to check the advantages of VR learning. In next steps we will let students to fill out a questionnaire to compare VR learning to regular learning. Accessible information and Edgar Dale's research make us believe, that this application has great possibilities in education.

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Acknowledgement
This work was supported under grant VEGA 1/0739/16, contracts APVV-0496-12, APVV-15-0763 and by company Virtual Medicine s.r.o.

E-LEARNING SUPPORT FOR TEACHING OF BIOSTATISTICS

Jiří Záhora, Martin Kopeček, Petr Voda, Iva Selke-Krulichová, Josef Hanuš and Pravoslav Stránský
Department of Medical Biophysics, Medical Faculty in Hradec Králové, Charles University
Šimkova 870, 500 03 Hradec Králové, Czech Republic, zahora@lfhk.cuni.cz

Abstract: *Formerly only the traditional forms of teaching biostatistics were used – lecture, seminar, practical exercise. It was found that number of lessons is not sufficient, previous knowledge of students is very low. The new conception is multilevel individual e-learning based teaching. This conception respects differences between needs of master's and doctor's degree. In the master's degree the more complicated topics use the traditional form with the teacher, remainder uses e-learning, students of course have possibility to communicate with the teacher. Needs of the doctor's degree are more complicated. The first step is arranged as the distance learning. Students must pass the test to can continue with one week long full day course. At the end they have to pass the final oral and practical exam. Very useful is also the interactive set of problems.*

Keywords: biostatistics, medicine, Moodle, e-learning, teaching biostatistics.

INTRODUCTION

Teaching of biostatistics at Medical Faculty in Hradec Kralove, Charles University and Faculty of Military Health Sciences of University of Defence is arranged by Department of Medical Biophysics for all levels (bachelor's, master's, doctor's degree). For many years before, the teaching was organized traditionally, lectures, seminars, practical exercises, tests were used. But there were some problems. To teach students everything, what may be considered as the basic statistics is not possible because we have too small space in the schedule for statistics. Another problem is very poor and variable level of the knowledge of mathematics and mathematical skills. And next problem is the very unpredictable area of the future application of statistics. On the other side, we have one great advantage – in our curriculum statistic is together with biophysics. Thus, in our coarse students can study basic statistics, but not only theory but they have possibility immediately to apply statistical laws on the real data. This real data are results of their own practical measurements. This data are also stored in so called school hospital information system [1, 2], so we can work with huge amount of the real data. These are the reasons, why we have decided to design the brand new conception and to create the complex environment for the teaching of statistics. Pedagogically is our approach based on the multilevel individual e-learning based teaching. As to the software, we use learning management system Moodle. This system is supported by Charles University and also by the world wide group of programmers.

1. THE NEW CONCEPT OF TEACHING BIOSTATISTICS

The new concept is multilevel individual e-learning based teaching [3]. Its main benefit is visible in the postgraduate course of biostatistics. The more complicated topics use the traditional form with the teacher, remainder uses e-learning, students of course have possibility to communicate with the teacher. The first step is arranged as the distance learning

using our e-learning courses – main topic is descriptive statistics. Students must pass the test to can continue with one week long full day course. At the end they must pass the final oral and practical exam. There is also certain space for some more special statistical methods after introducing this system [4, 5].

In the master's course we utilize the fact that in our curriculum biostatistics is together with biophysics. During the biophysical course students must past five practical tasks. All these practicals have similar structure – some task closed to biophysics and medicine, measurement, data analyses and conclusion. For example, to apply two sample t-test students must compare sensitivity of retina of the left and the right eye. Regression analysis is applied in the task, where students must study thermomechanical properties of nitinol stent or orthodontical springs [6, 7].

2. ABOUT ONLINE TEXTBOOK OF BIOSTATISTICS

2.1 Course content

The content of this course is very similar to the contents of other textbooks.

Description of the course:
Basic statistical concepts:
- Definition of terms statistics, population and selection;
- Characters and measurement scales;
- Data Collection.

Properties, accuracy and measurement errors:
- Properties of measuring methods;
- Measurement accuracy;
- Measurement errors.

Descriptive statistics:
- Characteristics of location;
- Characteristics of variability;
- Absolute and relative frequencies;
- Visualization of results.

Probability:
- Definition of probability;
- Probability calculations;
- Conditional probability, Independent events;
- Screening tests, sensitivity, ...;
- Probability distributions – Discrete random variables;
- Probability distributions – Continuous random variables.

Inductive statistics:
- Parameter estimation;
- Testing hypotheses;
- Parametric tests (Fig. 1);
- Regression;
- Correlation;
- Nonparametric tests.

Statistical software.
Bank of questions.

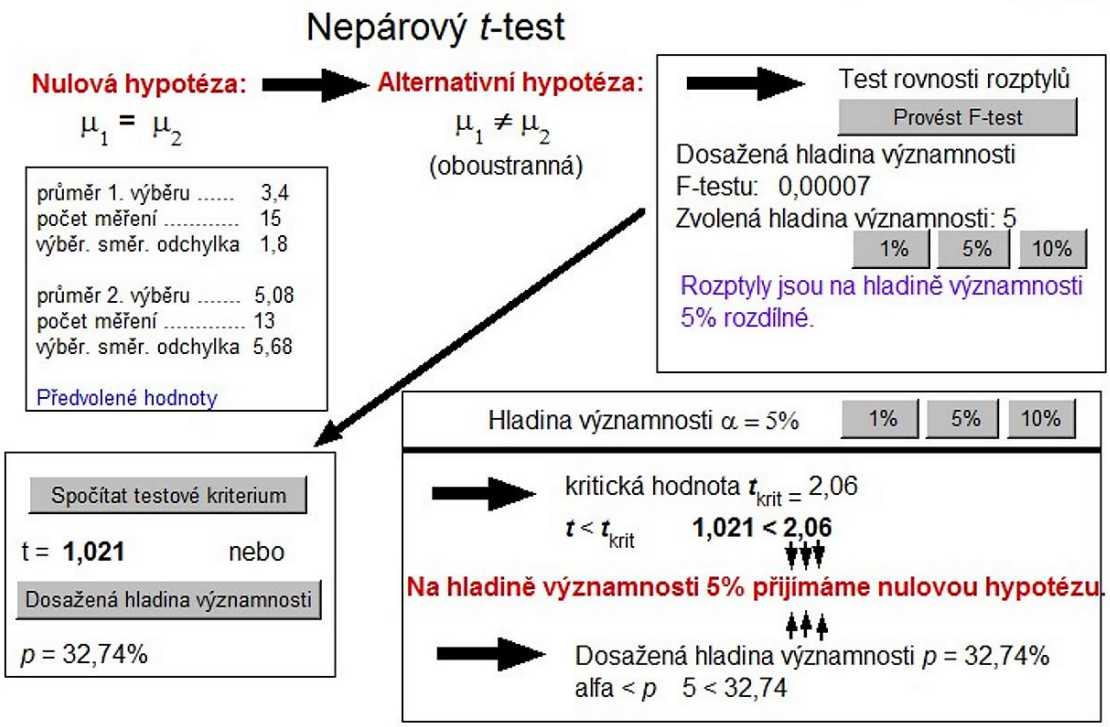

Fig. 1. The scheme of two sample t-test
Source: own

Every subchapter has three parts – short summary, theory and an interactive set of sample problems (Fig. 2). In every chapter the last subchapters contains test, dictionary and chat. Theory has form, which is in LMS Moodle called "Book". It has one great advantage and it is formatted printing of either one subchapter or the complete book.

2.2 Course administration

The course administration is determined by possibilities of LMS Moodle. From the point of view of student it is easy. They can use the calendar, chat, list of grades from their tests, list of course which they are using, list of upcoming events, printing. As to the teachers their possibilities depends on so called role. But generally, they can check all student activities, they can communicate with students. It is possible to create various databases which can be used for collecting and evaluating various student reports. Teacher can also administrate tests and bank of questions. We use two types of questions – "multiple choice question" and "calculated question". Calculated means, that student must solve the problem with randomly generated input values. After that the numerical result must be inserted into the result field. This value is automatically checked with 0.5 % tolerance. We have created the large question bank. Questions are organized in categories and up to three levels of subcategories. This system is very suitable for flexible designing of on-line tests.

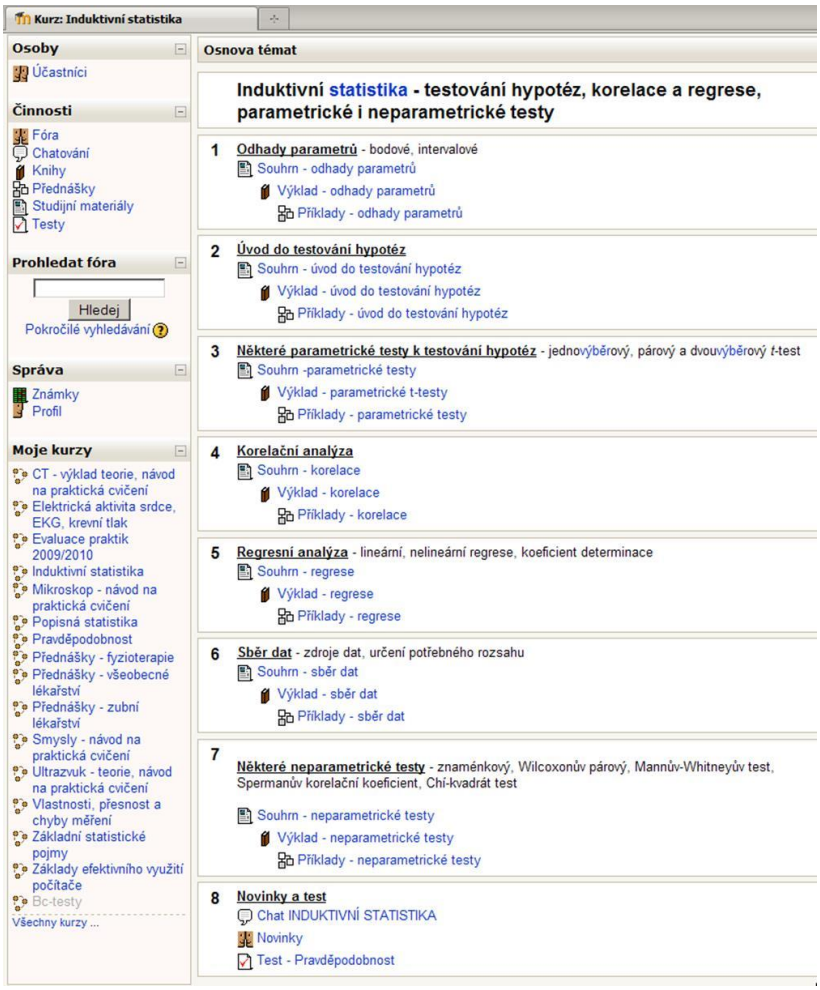

Fig. 2. The chapter "Inductive statistics" in environment of LMS Moodle
Source: own

2.3 Analyses of activities

We can find in LMS Moodle also a lot of tools for various analyses. Only briefly few words for the better idea, the LMS Moodle is not the subject of this paper. We can analyse results of test including graphical visualisation. The whole test and any separate questions in the test are evaluated. A set of parameters as facility index, intended weight, effective weight … It is possible also to trace all so called "Activities".

Of course, it is worth to quantitatively evaluate effectiveness of new training. Unfortunately we have not data enough currently to do it.

3. GOALS FOR THE FUTURE

There are three main directions. The first one is to expand our question bank. The second one is to create the chapter "Case studies''. In this chapter, the real problems from the clinical practise and research will be statistically processed. The third one is related to one of our other efforts – remotely controlled measurements and virtual experiments [8]. The basic idea is to design system for the remote measurement connected with the on-line statistical

processing. In the ideal case students should can suggest and realize the corresponding statistical solution.

CONCLUSION

It was found, that this conception is very effective and flexible. All materials are available for students any time (moodle.lfhk.cuni.cz). All results as test grading or activities are automatically archived and may be later analysed. The whole course can be improved continuously and the question bank may be enlarged too. Also it is beneficial that students can work with their own acquired real data.

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Acknowledgement
This work was supported by the program PROGRES Q40-09.

DISTANCE LEARNING IN EUROPEAN HIGHER EDUCATION

Lucie Zormanová
University of Jan Ámos Komenský Prague
Fryštátská 80/20, 73301 Karviná 1, Czech Republic, l.zormanova@centrum.cz

Abstract: *In many European countries distance education has a long tradition. Such a degree of openness and flexibility will be offered by few higher education institutions, mainly by Open Universities which is concentrate exclusively on distance education. This article is focused on distance education in European higher education. It analyzes and compares the development of distance learning, supply of study options in higher education in European countries; covers the development and conditions of distance learning in European countries. The carried out analysis shows that currently there is an emphasis on life-long learning and the development of distance learning has become a priority. It can be stated there are significant differences in the development of distance education in higher education in individual European countries.*

Keywords: open university, distance education, electronic system, life-long learning, models.

INTRODUCTION

Nowadays, the emphasis on lifelong learning and education is becoming a regular part of everybody's life. But combining work and family responsibilities and study requirements is demanding, so that universities are solving this problem by using distance learning. Nowadays in European countries it is already possible to acquire higher qualifications in many fields of study through distance learning using an electronic system of learning, i.e. e-learning [9].

1. ORGANISATIONAL MODELS FOR DISTANCE EDUCATION

There are many types of organisational structures for distance education. A particular model might be dominant in one country, while in another country there might be a mixture of co-existing models.

One country may contain a variety of different organisational models for distance education: mostly a large single mode institution, and a number of independent dual mode institutions.

In Europe we meet with various forms of implementation of distance education. Divergence appearance and development of distance education in different European countries are caused by different cultural aspects, different educational systems and different legislative norms on the area of education, including distance learning. A major role has the tradition of distance learning, the development of information and communications technology in the countries, the rate of use of ICT in education. An important aspect, which supports the development of distance education, is the population density of the country and the availability of educational institutions for all the population in terms of spatial distance [2].

2. SINGLE MODE MODEL

Universities which conform to this model, mainly open universities, only provide distance education. This model is characteristic for supporting a large national institution funded by public finances, which specializes in distance learning of all types and levels. This model is now assumed by various European countries, especially Spain [8].

Characteristic for this model is that the curriculum, student support and accreditation are designed to suit students studying at a distance. The staff is interested in developing and enhancing distance education methods and they do not demands face-to-face teaching. Sometimes there is also a regional network of study centres where students and tutors sometimes meet for consultation. These universities may have high setting-up costs but their unit costs per students are generally lower than in traditional universities.

2.1 British single mode model

This model is characteristic by the university offering educational opportunity and social justice by providing quality higher education to all who wish study.

Additionally, students are not required to have prior educational qualification to start studying there.

Case study: Open University in United Kingdom

Great Britain is famous for its Open University with headquarters situated in Milton Keynes [9]. The Open university is the largest open university in the world. Not counting its headquarters, the Open University consists of thirteen regional offices throughout the UK and nearly three hundred study centres, mainly in the UK.

The Open University was established and incorporated by Royal Charter in 1969 as an independent institution authorised to confer its own degrees (for example it is the largest European education institution that confers an MBA degree) [9] and undertake professional training. It was founded to allow quality education to people who had work and family responsibilities so that they could not regularly attend higher education.

No educational qualifications are required for admission to undergraduate courses, but students must be at least eighteen years old and resident in any of the countries with which a formal agreement has been reached.

The Open University offers three types of programmes: undergraduate, postgraduate and other areas of continuing education.

There are eight faculties and schools: Faculty of Arts and Social Science, The Open University Business School, Open University Law School, Faculty of Science, Technology, Engineering and Mathematics, Faculty of Wellbeeing, Education and Language Studies, Institute of Educational Technology, Knowledge Media Institute, Centre for Inclusion and Collaborative Partnership [14].

2.2 German single mode model

The German model is characteristic by its Fernstudium, which means the distance education at the higher education level is only provided by institutions of higher education. These institutions can also provide programmes of Fernunterricht, which means distance training.

The other characteristic is the encouraging of distance education in higher education by the Ministry of Education and regulation of distance form of study by government.

The German model is also implemented in Portugal and the Netherlands [8]. In the Netherlands the use of media in higher education is encouraged by the Dutch Ministry of Education, Culture and Science [4].

In Germany, the distance form of studies is regulated by the Student Protection Act to protect students who study at distance learning programmes [7], [5]. In Portugal the distance form of studies is also regulated by the government [4].

Case study: FernUniversität in Hagen

The FernUniversität in Hagen is the only distance teaching university in the German-speaking countries and regions maintained by the state. It offers two types of programme: undergraduate and postgraduate with high-quality final degrees (Bachelor, Master and Doctorate). There are four faculties: Faculty of Humanities and Social Science, Faculty of Mathematics and Computer Science, Faculty of Business Administration and Economics, Faculty of Law [16].

2.3 French single mode model

In France, where is a long tradition of distance form of studies (the radio used to broadcast education courses implemented by Sorbonne University since the 1920s), is an organisational model of distance education which is characteristic of state-supported institutions for distance learning. These institutions, which offer distance education, are interdisciplinary structured, provide education at all levels, cooperate with traditional universities, colleges, and other education institutions providing full-time studies [8], [9].

The distance form of studies is also regulated by state. Further Education and Training Act and the Apprentices Act define the distance form of studies as an integral part of the education system in the context of continuing education [8], [9].

Case study: CNED

The National Centre for Distance Education (CNED in French) was established in 1939. It is a French public institution under the oversight of the Department of Education. It has been using distance learning material since the mid-1990s. It offers around 3000 programs from kindergarten to university level [18].

3. DUAL MODE MODEL

Typically, universities providing this organisational model of distance education teach both full-time students on campus and part-time students at a distance. Both types of students

follow the same syllabus, take the same exams. There are teaching materials being used which have been developed for distance students. In this type of universities distance education is integrated into the structure of traditional university. Distance education in dual mode institutions usually operates on a relatively small scale in comparison with single mode institutions.

3.1 Irish dual mode model

In Ireland there is a specialized distance teaching unit embedded in conventional university such as OSCAIL [3], [7].

The Irish organisational model of distance education is characteristic by the cooperation of universities with other education institution, which offer distance education - with National Distance Education Council (OSCAIL) and with British Open University. The National Distance Education Council (OSCAIL) is set up and supported financially by the government, it makes evaluation of distance education and measures its quality, and encourages the development of distance education [3], [8].

Case study: OSCAIL
OSCAIL was established as the National Distance Education Centre in 1982 in Dublin. It offers these study online programmes: information technology, business, management, sustainable development, humanities and nursing. OSCAIL is also focused on research in innovative distance education and e- learning technologies [13].

4. RUSSIAN CONSULTATION MODEL

The consultation model is an organisational model of distance education which was developed in Russia and exported to Central and Eastern Europe. Its characteristic is that it partially involves face-to-face teaching, which means that part-time students study at home through e-learning and they also attend consultation sessions where they meet their teacher, faculty staff. Another characteristic of this model is that it is provided in institutions which teach full time students, part time students and consultation students together. For student support there are only a few specially-produced learning materials, and the system mainly relies on the use of traditional textbooks. The teachers are the same as for full time students and also the form of exams is identical to full time students.

5. MODEL OF CONSORTIA

This model is characteristic by two or more institutions which share distance learning materials. These partners may be universities or university departments, which realize traditional, single or dual mode education, government agencies, production companies, etc. Each institution as a consortium member has its own management structure.

5.1 Nordic model of consortia

The Nordic organisational model of distance education is typical by its association of universities and other education institutions offering distance learning. Institutions, which offer distance education, mostly have a mutual managing authority within the association

(mainly a common regional centre), these institutions provide a dual education system, meaning a combination of full-time and distance learning at the same time. These institutions provide graduate studies and also various types of adult education courses [7], [6].

The Nordic model is implemented in Sweden, Denmark, Finland, and Italy.

Case study: Aarhus University

Aarhus University is a member of the Danish Association of Open Universities, which was founded in 1995 as a prolongation of Jutland Open University, established in 1982. It consists of four faculties. The most interesting faculty of them is Faculty of Arts which contains several institutes; one of them is the Centre for Teaching Development and Digital Media [15].

Danish Association of Open University (DAOU) was established in 1995. It is association of universities which realize dual mode model [16].

5.2 Italian model of consortia

In the Italian model universities cooperate with companies and share learning materials. Administrative responsibilities are shared between the National Centre and the partner universities.

Case study: NETTUNO (Network per l'Universita Ovunque)

NETTUNO was founded in 1990. Nowadays it has transformed to the International Telematic University UNINETTUNO. It consists of forty-three universities (including eight in Albania) and major telecommunications companies. Administrative responsibilities are shared between the National Centre which provides the national co-ordination, and partner universities, which enrol students and set up study curricula, timetables and examinations. NETTUNO offers two types of programmes: undergraduate and postgraduate, and offers a variety of diplomas in law, communication, engineering, economics, literature, psychology and architecture [11].

6. FRAINCHISING IN CENTRAL AND EASTERN EUROPE

This model is characteristic by franchising partner institutions. Distance learning courses from one institution are used in these partner institutions and sometimes adapted. Students are normally registered and accredited together. The Open University collaboration in Central and Eastern Europe is an example of this model.

Case study: Open University Business School

The Open University Business School has worked with countries in Central and Eastern Europe since 1989. The first school was established in Hungary in 1989. The courses have been translated and adapted for students from Central and Eastern European countries. This has been financed through the UK government's Fund. Partnerships were set up with organisations in each country which allowed them to adapt courses; meaning that courses were translated into students' native languages and changed in up to 30 % to suit the local circumstances [12].

CONCLUSION

Currently, the European countries are characterised by a dynamic development of distance education, which is related to the development of technology. There are many differences among European countries in the development of distance learning and also in the organisational structures for distance education; something typical of individualistic European countries.

Western European and Nordic countries have a long tradition of distance education, while Central and Eastern European countries have a richer tradition of state-supported evening and distance learning which was based on face-to-face teaching. In Western and Northern European countries, especially in Great Britain, Norway, Germany and France, distance education has a long tradition – a great example being the UK's first courses of distance education initially realized in the form of correspondence courses (these courses started in 1840).

In Central and Eastern European countries the distance education has been developing since 1990s [1], [6], [2].

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