ICEE 2015

19th International Conference on Engineering Education

July 20-24, 2015
Zagreb, Zadar (Croatia)

New Technologies and Innovation in Education for Global Business

zagrebačka škola ekonomije i managementa
zagreb school of economics and management

International Network for Engineering Education & Research
INEER

Under the auspices of the Ministry of Science, Education and Sports

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July 20-24, 2015, Zagreb, Zadar (Croatia)

NEW TECHNOLOGIES AND INNOVATION IN EDUCATION FOR GLOBAL BUSINESS

BOOK OF ABSTRACTS

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Content

Message from the General Chair

Welcome to ICEE 2015

Professor Đuro Njavro, Ph.D., Dean

Conference Chair

On behalf of the Conference Organizers, it is with great pleasure that we welcome you to the 19th International Conference on Engineering Education (ICEE 2015): New technologies and innovation in education for global business. With Croatian Ministry of Science, Education and Sports and Polytechnic of Zagreb as our partner, we expect this Conference to offer a perfect mix of science and networking.

Croatia has a long tradition of producing engineering excellence within the institutions with a distinguished reputation of its outstanding scientists. ZSEM, as well, has hosted many international conferences with huge social and scientific impact. This particular one will continue the iNEER tradition of quality, highlighting the developments in engineering education as well as focusing on innovation, globalization and networking.

The conference aims to be the ideal platform for making international connections for future collaborations in various academics field. Also, it will allow the exchange of the best engineering practices that concern emerging areas related to entrepreneurship, management and education.

While the breadth and depth of the Conference will keep you busy, we encourage you to extend your visit and enjoy all that ICEE 2015 has to offer. Take a trip to Plitvice lakes, our oldest and most popular National Park. In 1979 the National Park Plitvice Lakes was listed on the UNESCO list of natural World Heritage. Enjoy lakes and views of waterfalls, amazing flora and fauna while driving boat and walking through the park. Furthermore, take the opportunity to visit Zadar, a city monument, surrounded by historical ramparts, a treasury of the archaeological and monumental riches of ancient and medieval times, Renaissance and many contemporary architectural achievements such as the first sea organs in the world.

Once again welcome. Welcome to the leading higher education institution in Croatia in the usage of e-learning as well as a proud holder of the Association of Advance Collegiate Schools of Business (AACSB) accreditation, Zagreb School of Economics and Management (ZSEM), welcome to Zagreb, welcome to beautiful Croatia where the great Nikola Tesla was born.

We look forward to sharing this week with you!

Conference chair

Đuro Njavro, dean, ZSEM

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Karmela Aleksić-Maslać, Associate dean, Head of the ICT department, ZSEM

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Conference Program

Monday, July 20, 2015		
8:00-17:00	Trip to Plitvice Lake	
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19:00-21:00	Welcome Party	ZSEM Campus
Tuesday, July 21, 2015		
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	Workshop Teaching Technology Entrepreneurship at Engineering Universities - Experiences, Perspectives, Challenges, and Assessment Sergej Lugović	Ouverture
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11:00-13:00	**Parallel session ThC1: Mathematics in Engineering Education** 17 - Engineering Students' Perception of Studies – a Comparison Based on the Students Educational Backgrounds Janne Roslöf 19 - Mathematical vs. Engineering Understanding: Engineering Students' Perceptions (Work in Progress) Ira Raveh, Elena Trotskovsky and Nissim Sabag 44 - Problem-Based Learning as a Strategy for Teaching Mathematics at Northwest La Salle University Eusebio Jiménez-López , Gloria Isabel Morales-Bojórquez , Gabriel Luna-Sandoval , Lilia Beatriz Navarro-Fragoso , Martín Santacruz-Tirado, Ramsés Alonso Acuña-Espinosa , Rafael Durán Gibrán Amparán, Jesús Armando Cantú-Cárdenas 76 - Using Educational Technology to Enhance Mathematics Learning Einari Kurvinen, Rolf Lindén, Teemu Rajala, Mikko-Jussi Laakso and Tapio Salakoski 141 - Can Artificial Intelligence Help STEM Students Develop Intelligence? Larissa Fradkin and James Uhomoibni	Ouverture
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16:00-17:00	ICEE2015 Closing Ceremony	Panorama
19:00-22:00	Conference Gala Dinner	
Friday - July 24, 2015		
8:00-20:00	Trip to Zadar	

Keynote Speaker 1

The Impact of Technology on the Educational Process

Siniša Krajnović, Vice President and Head of Development Unit Radio at Ericsson AB, Professor and Program Director of the General MBA Pogram at Zagreb School of Economics and Management, Professor at Luxembourgh School of Business

Keynote Speaker 2

What Makes Silicon Valley and Stanford University Tick?

Prof. Krishna Saraswat, Department of Electrical Engineering, Stanford University, Stanford, CA 94305 USA

Since the early part of 20th century Stanford University has had a meteoric rise and is regarded today as a top teaching and research institution in the world. Since middle part of the 20th century Silicon Valley has developed from small towns surrounded by farmland into a leader in innovation. Silicon Valley accounted for less than 1% of U.S. population, about 12% of all new U.S. patents and 50% of all new patents coming from California in 2009. Silicon Valley per-capita income is much higher than U.S. and California averages. But so is the cost of living. How can Silicon Valley sustain such a high cost of living? What are the secretes of the success of Silicon Valley and Stanford?

Keynote Speaker 3

Prof. Boris Podobnik, Associate dean for research at Zagreb School of Economics and Management

Parallel session TuA1

Distance Learning, E-learning and Blended Learning 1

171 - Developing E-Learning Models of Multimedia Instructional Design and Implication for Special Students

Kuei-Chih Chuang, Pang-Tung Liu, Yi-Tung Lin, Biing-Huei Chen and Hsia- Li Yang

The content of this project is utilized from "National Digital Archives Programs, Taiwan" (NDAP) where offers the organizing and assessing E-Learning Models of Multimedia Instructional Design and Implication. We make the digital teaching material match the actual teaching demanding, develop, and study the tactics and ways effectively to focus on the unit of "Water Circulation" of "Environment and Life Science and Technology" for K-12 school courses. We develop several teaching materials and the content "Going to the Toilet by Oneself" for the disable students of special education to assess the teaching effect via the seed teachers, and try to set up the studying-type community. This paper will propose to make the procedures concretely, to demonstrate them in the digital content, and to discuss the assessed effects for E-Leaning.

130 - Exploring the Internet of Cooperative Learning Groups Using Content Analysis on Cohesive and Collaborative Tasks in E-Learning System

Kuei-Chih Chuang, Yi-Tung Lin, Chin-Tung Chen, Wen-Shan Lin and Mei-Chuan Tsai

This study purpose was to explore the Internet of Cooperative Learning Groups using Content Analysis for Cohesive and Collaborative Tasks. According to the study samples of graduate students attending "Comparative Vocational and Technological Education course" at Graduate School of Vocation & Technological Education, National Yunlin University of Science and Technology, T-University in Taiwan. There were 23 graduate students in class, divided into six cooperative learning groups using instructional materials and activities via e-Learning system that was using the Internet as an academic instructional platform. During the class, there were five times of students coming to class face to face, eight times in synchronous learning ways, five times in asynchronous learning ways. Using the Internet online and real time ways for discussion groups, the anticipants shared the course contents, and panel's reports with each other. For reference of content analysis of "Students online discussion Dialogue WPBL" cooperative task model of Tsang Kwok-hung, the study method defined respectively problem determination, recognition and discovery, planning, alternative, dialogue type construction and evaluation for early the fourth week, mid-eighth week, the end of 15th week in the conversation contents. Comparing to each group, the study analyzed the Internet cooperative learning groups to discuss the distribution of dialogue situations and the total number of dialogue cohesion.

33 - An investigation of the use of the Blackboard Learn Mobile App: An African perspective

Marisa Venter, Riaan Van der Walt and Arthur Swart

Learning management systems, such as Blackboard Learn™, have become synonymous with higher educational institutions over the past few years in an effort to improve student engagement with course material and with academics. However, some students and academics of Blackboard Learn™ have criticized the system as being "technologically years behind", with an awkward, slow interface which makes basic tasks difficult to execute, while navigation within the system proves time consuming. Subsequently, Blackboard Inc. announced,

at the end of 2013, that they had completely redesigned their mobile learning app after extensive analysis of how students use mobile devices for education. They claim that their updated version of the Blackboard Learn Mobile App simplifies content consumption which will lead to a more engaging user experience and greater productivity. The purpose of this study is to investigate these claims by determining to what extent students are using the Blackboard Learn Mobile App on their mobile devices while also obtaining their perceptions regarding the use of this app. There is currently very little scientific research available that can shed light on the use of this app within the African context. The target population is restricted to IT Students enrolled at the Central University of Technology in South Africa, where both quantitative and qualitative data was collected using a survey questionnaire as the data collection instrument. The results indicate that a large percentage of students are not using the Blackboard Learn Mobile App because the data costs are too high and their devices do not support the app. Some students are not using the app because they do not see the need to download the mobile app and are satisfied to use the desktop PC's on campus to access Blackboard. The usability study of this app revealed several problems which are currently encountered by students with regard to watching YouTube videos, posting replies on forums, doing assessments and submitting assignments.

89 - Creating a Collection of Assets in Electrical Engineering – a Project under Way

Ana Pavani

Information and Communication Technology tools provide both infrastructure and contents to enhance education. Engineering Education can benefit from ICT tools due to its nature – simulators, animations, online exercises can motivate and help the understanding of dynamic phenomena, for example. Development of good quality courseware is time consuming and requires financial resources. A team of different professional profiles is necessary to introduce good visual quality, develop interactions, etc. In order to lower costs and development time, it is important that contents be reused; this is one of the targets of content developers. A characteristic that contributes to the reuse of contents is their sizes or granularity. Another is the way they are managed to allow them to be searched, found and retrieved. When this happens, they are said to be structured. Besides the contents that are used to build lessons, modules, courses and curricula, there is a smaller digital component that belongs to contents – the asset. Though assets are not used directly in the learning process, they contribute through learning objects. Assets can be structured to be reused too. This work presents a project that created a collection of assets in Electrical Engineering – they are managed by a system that is at the same time an Institutional Repository and a Learning Management System.

136 - Developing the C-EWBST of Digital Multimedia Instruction for Vocational High School Curriculum in E-Learning System

Kuei-Chih Chuang, Chin-Tung Chen, Yi-Tung Lin and Wen-Shan Lin

In this rapid transmission of information and innovation in the 21st century, through interactive computer multimedia instruction materials, not only as an auxiliary tool when teaching, but also allow students to self-study after school. Most of experts believe that the vocational skills certification system is the assessment, the best way to skill teaching and checklist the vocational training of vocational education, industrial wiring skill learning is a hands and brain skills formation process of circuit theory to understand, but after long-term operation to achieve the learning outcomes. Through lectures of the digital multimedia teaching methods, we can understand the students' reactions and views of multimedia teaching, thereby improve and enhance the skills of teachers in the use of multimedia teaching, improve teaching effectiveness. Therefore, this subject of study will step the Class C Electrical Wiring Branch Skill Test (C-EWBST) accredited by teaching technical subjects design and planning, research and development made into a suitable computer interactive multimedia materials, the use of Flash and other software designed for students to develop self-learning and digital

textbooks. And convert APP software, built on the site, when the mountain peak of action available to play and operate the vehicle to address the skills of students with learning difficulties in industrial wiring and complexity of possible ways, but also provide students with the individual,repetitive and immediate concept of learning and the active construction of knowledge, environment and platform. Finally, offer a number of findings and recommendations for vocational teachers, vocational training institutions and education authorities.

144 - WIKI-Based Project in Engineering Education: Evaluation and Considerations for Effective Use

Gláucia Nolasco de Almeida Mello

Although Web 2.0 communication tools like blogs and wikis have been used for supporting collaborative learning there are not many reports about implementation of that resource on engineering in Brazil. This paper reports on the use of Wiki as an online didactic tool to provide new opportunities to pro-active and collaborative writing in engineering education. The project was developed to support a collaborative space discussion for specific topic of the discipline Reinforced Concrete Structures at 4th year of Civil Engineering course. The wiki was created in Wikispaces platform (http://www.wikispaces.com/). A total of 43 students were invited to participate in four-week online activities and they were monitored during their participation. The perspectives of students on this experience were gathered by informal interviews, analysis of the content and number of comments made by students and statistical analysis of the data collected from the Wikispaces platform and Google Analytics (http://www.google.com/analytics/). Some students related that wiki was a nice tool for collaboration work and file sharing. However some students also reported that the wiki's development it was difficult. Finally, it is presented in this paper some considerations for effective use of wikis as collaborative writing tools in engineering education.

Parallel session TuB1

Best Practices in Engineering Education and Research 1

75 - Creating Software Engineering Entrepreneurial Awareness through Hands-on Interaction with Real Entrepreneurs

Amalia Rusu, Adrian Rusu and Mike Roer

The fast-evolving technological advances make it easier for entrepreneurs to implement their ideas and reach their users. Because of their training, generally entrepreneurs come from a business background rather than an engineering background. On the other hand, computer science and engineering students are the ones who have the technical skills to develop most of the technology-related entrepreneurial ideas. However, computer science and engineering curriculum usually does not provide room for entrepreneurial exposure. Even the real-world environment is experienced by computer science and engineering students mostly through limited time and scope internships. In this paper, we propose a framework to seed entrepreneurship during computer science and engineering students' studies and to encourage continuation during their professional career. The goal of our proposed framework is two-fold: computer science and engineering students start working in the real-world, experience state-of-art development technologies, and at the same time their entrepreneurial spirit is ignited and maintained. We present several case studies, in which we applied the educational aspects of our framework that led undergraduate and graduate students enrolled in software engineering courses to closely collaborate with real entrepreneurs, and developed software tools that are being used by entrepreneurs to enhance and market their ideas.

12 - Preparing Mechanical Engineering Design Students for Computational Fluid Dynamics Code Development

Desmond Adair and Martin Jaeger

CFD is now a useful tool for mechanical design engineers. CFD has also gained a broad acceptance in engineering education, and has been adopted at undergraduate and postgraduate level course in many universities. The teaching of CFD at the undergraduate level however usually focuses on giving students an understanding of the numerical methods and details involved, supported by what are little more than code fragments, followed by learning an abstract form of CFD skills and processes, without any real interaction with the complex core computer coding behind what is often just "easy-to-use" or "push button" commercial interfaces. Quite often, as the student progresses in his/her use of CFD, especially in the research area, it becomes clear that an "off-the-shelf" commercial CFD package is not able to satisfy all requirements to simulate a given problem fully, nor to obtain accurate results. Code development has to be undertaken to enhance the commercial code's capabilities with the insertion of say additional FORTRAN coding or through MATLAB. The purpose of this paper is to outline what must be taught to add computer coding to what usually is a well protected, though capable of being compiled and linked, core computer code so that the complexity of interacting is lessened and better understood.

126 - A Spreadsheet-Based Model of Light Reflection on Thin Layer to Improve Understanding of Optical Phenomena

Michal Musilek, Tomáš Bartoň and Petr Musilek

Optics, as well as other areas of physics, has numerous applications in engineering. In addition to the construction of optical devices and instruments, such applications include a number of measurement methods based on optical phenomena. Prime examples are the decomposition of white light into the colour spectrum, the formation of interference patterns, or polarization of light. We encountered an interesting engineering problem while studying reflection of light on a thin layer formed by macromolecules of polyunsaturated isopropylacrylamide. Thickness and structure of this material varies depending on the temperature and pH of its immediate environment. A monolayer microgel is sandwiched between two thin metal layers, typically gold, that act as semitransparent mirrors. In principle, such thin layer device can be used to develop a contact probe to measure the temperature and/or pH of soil. The microgel etalon can be used as a device to improve understanding of light interference in advanced engineering courses. Students are provided experimental data measured on such a thin layer using a spectrometer, along with the spectrum of the light source prior to reflection on the thin layer. Their task is to create a mathematical model of the observed optical phenomenon. The model is to be implemented using a spreadsheet that calculates the interference of the reflected beam on both semitransparent mirrors for individual wavelengths. Relative intensities obtained this way can be plotted on a graph and compared to the graph obtained experimentally. The students have to create a model that best corresponds to the measurements. This empirically formulated solution to the complex problem of light interference by reflection on thin layer leads to a deeper understanding of the phenomenon compared to a classical simplified model from introductory courses in general physics, i.e. from theoretical model derived through deduction.

37 - How Electrical Engineering Students Understand the Accuracy Concept Concerning Digitized Signals

Elena Trotskovsky and Nissim Sabag

Previous studies have shown that engineering students have many difficulties understanding the concept of accuracy. A previous study exposed students' misunderstandings in Digital Electronics course. These misunderstandings are linked to digitizing of electrical signals. To overcome students' difficulties, teaching the accuracy issue in the course must be expanded. The current research investigates students' achievements after adding concepts about accuracy to the course content. Sixty-one electrical and electronics engineering students who took the course in Fall semester 2014 participated in the study. Two sets of questions concerning the concept of accuracy, applied in the context of the course, were developed and appeared in the final exam. The problems concentrated on measurement errors in digital systems, including analogue to digital converters. Both sets of problems required students to provide calculations and explanations. Their written solutions and explanations were analyzed. Examination of students' answers shows that the frequency of errors concerning accuracy found in previous studies was reduced. The analysis revealed new aspects of students' misunderstandings concerning the accuracy of digital instrument measurements. Considering the results, we suggest further improvements to the course content and continuing research to strengthen understanding of the accuracy concept.

127 - An Autonomous Learning Ability Based Laboratory Course for Undergraduate Students Studying in Measurement and Control Subjects

Pengxing Yi, Junfeng Wang, Tao Huang and Bo Wu

We report a study of a specific measurement and control lab course at one university over 4 years. We found that when we taught the lab section in measurement and control subjects with a traditional course schedule, the teaching process doesn't encourage students to think actively and the students' creativity can't be inspired as we expect. To overcome this problem, we introduced an independent experimental course, which integrates the main crux of both the Basic Mechanic Engineering Control course and the Measurement Techniques of Mechanic Engineering course. In this lab course, the students are divided into small teams with three members, and they should corporate to design and develop a small mechatronic control system integrating measuring module and control module. In the whole learning process of this course, each team should complete demonstration of scheme, system design, manufacturing and assembling, system test, report writing and competition with a proper cooperation within their team. To broaden the students' horizon, experts in measurement and control will be invited to give the students several hours' lectures about measuring and control techniques in engineering practice. In addition, the lab instructor only acts as a project assistant rather than a decision-maker in the lab learning process, and his main duty is to supervise the working procedure of each team and provide some necessary guidance when some teams run into a problem. Therefore, the students can think actively, and also their autonomous learning ability can be aroused to the greatest extent.

54 - Freshman Engineering Students Prefer Time-on-task in a Solar Energy Course, rather than Time-in-class!

Pierre Hertzog and James Swart

Within higher education, student feedback or perceptions are useful in measuring effective instruction and are important to evaluate the nature and quality of educational interventions. Research has indicated that undergraduate engineering students really enjoy practical work scheduled in an electronic communication laboratory, thereby indicating a measure of student satisfaction. However, what do freshman engineering students enrolled for a course in Solar Energy prefer, time-on-task or time-in-class? The purpose of this paper is to present student perceptions of practical instruction offered in a Solar Energy laboratory at a university of technology. An exploratory case study is employed along with descriptive statistics of the quantitative data. An electronic response system was used in a classroom environment at the end of the course to obtain student perceptions on whether the practical instruction was enjoyable, challenging, relevant, sufficient and recommendable. A total of 84 student perceptions where gathered where 92% of the students indicated that they enjoyed the practical work done in the laboratory. 93% of the students felt that the work was relevant to the theory done in the classroom and 89% felt that more practical experiments should be done. The results of this study show that students view practical experiments in a Solar Energy laboratory as an important part of their educational development. Subsequently, it may be stated that freshman engineering students would prefer to spend more time-on-task than time-in-class where they can develop the needed skills and graduate attributes to be successful in a specific society, community or industry.

Parallel session TuC1

AOL, PBL and Quality Assurance 1

57 - Development and Uses of Iterative Systematic Literature Reviews in Electrical Engineering Education

Branimir Pejcinovic

It is expected that most, if not all, graduate students will posses skills necessary for doing literature reviews. It is less clear how to teach these skills most effectively especially to students who are area novices and unfamiliar with review process. Systematic literature reviews offer a solid instructional framework which can be implemented across curriculum and offer an opportunity to teach course material differently so that student learn not just the literature review technique itself but also some segment of the course material. Our pilot study investigated issues related to practical implementation of systematic literature reviews in two classes, with different course lengths and purpose of review assignments. Our initial results are encouraging: students' selfefficacy with respect to ability to do reviews improved and they think that this skill is useful. We have developed a new rubric for evaluation of final reports as well as weekly schedule of tasks.

67 - Some Insights to Quality Improvement in Engineering Education System

Ivan Szendiuch, Edita Hejátková, Alexandr Otáhal and Boleslav Psota

The content of this paper is to recall some facts about the application of the quality system in the academic sector. The goal of the application of the quality system at the University is not only to ensure the quality of teaching, but gradually improvement at all levels of management and organization that will lead to raising the professional level of students. Quality is often used words about, but many people are unaware of its real meaning and, above all, its application in practice. Fortunately, there are practical experiences and results from the manufacturing sector, where after the Second World War, Japan was able to turn the theory of Edward Deming in the economic miracle. As a result, then a series of quality systems, which have been and still are successfully used in a number of companies, for example ISO, TQM and others. Unfortunately, in the academic sector is no uniform system of quality and there is a question whether he could in the realty exist. Detection and monitoring data is full responsible and fundamental step in all quality systems. There are some options, but for its successful introduction, several conditions must be met, which are mentioned in this paper. It is emphasized that the human factor in the educational process is prevailing indicator compared to the manufacturing sectors, where are measurable errors and non-conformed products. Understanding the basic principle and the importance of the quality system is the first step of its implementation. This paper outlined some basic principles related to the application of the quality system at the university. It must be understood when the quality system is correctly applied, brings both process improvement and also increasing of their efficiency.

61 - Significantly Improved Student Progression Results by Means of Course Integration and Collaborative Pedagogy in the Degree Programmes of Electronics, Electrical Engineering and Automation Technology of the Helsinki Metropolia UAS

Heikki Valmu, Raisa Vartia, Eero Kupila and Tuomo Heikkinen

The curricula of all the engineering degree programmes of the Helsinki Metropolia University of Applied Sciences went through a fundamental change in 2014. Most old programmes were merged and the pedagogy is based on collaborative teaching and learning. The studies of most engineering programmes are organized in modules of 15 ECTS credits (10 weeks). The modular structure facilitates cooperation between programmes and gives the students a much wider variety of choices in their study path. The degree programmes of Automation Technology and Electrical Engineering (tuition in Finnish) were merged and combined organizationally as well to the degree programme in Electronics (in English). It was decided that all the courses within the study modules in these programmes will be completely integrated and one study module thus consists of just one single course of 15 ECTS credits based on course integration and collaborative teaching between multiple members of academic staff as well as continuous assessment throughout the course leading to one single grade only. The goal was to improve the student progression since the current funding model of the Finnish UAS's is heavily based on it. The first results after the first semester reported here show that this model significantly improves the results and more than 93% of all the students in these degree programmes have passed all the courses in time compared to the relatively low values of 70% in 2013 and 50% in 2012.

162 - An Evaluation of Three Freshman Experience Classes

Maria Hasenhuttl, Marilyn Kaplan and Simeon Ntafos

The strong job market in Engineering and Computing is attracting more students to these majors but shortages at crisis levels are still widely projected. Freshman retention is an important factor affecting graduation rates and number of degrees granted. Most Universities use freshman experience classes/seminars (and other methods to provide incoming students with the skills and encourage behaviors that will help them succeed in these demanding majors. In this paper we discuss and evaluate three freshman experience classes: a university-wide class during 2007-2010 and its School-based successors in the School of Engineering and Computer Science and the School of Management during 2011-2014. We report on approached used, retention rates, evaluations and lessons learned.

46 - Changes and Challenges in Engineering and Computer Sciences Education - Guidelines to Treat Wide Themes for Beginners

Clara Amelia de Oliveira

This paper explains thematic approach formulation looking for beginners´ context at Engineering and Computer Sciences courses. First task is to present an introductory text for the students. The text shows how wide themes, titled thematic, wed with Object Oriented knowledge modeling tool to achieve the thematic formulation at first glance. The paper illustrates a practical example of introductory text in the Environmental Engineering field of knowledge. After this, it is presented a case example of a Numerical Analysis teaching topic under, both, traditional discipline oriented approach and thematic oriented approach. Conclusion enhances it is possible to implement thematic oriented view also in very traditional discipline oriented curriculum. The proposal challenges teachers and students because it effectively changes engineering education towards new curricular approaches. The ´change´ is to treat knowledge as a wide theme at first glance. The ´challenge´ is to understand this concerns a paradigm shift, adequate to deal with educational demands at globalization times including technological areas.

Parallel session TuA2

Best Practices in Engineering Education and Research 2

87 - Design of a Hands-on Mechantronic Project Integrated into an Introductory Course

Youmin Hu, Thomas Kurfess, William Singhose, David Frakes and Bo Wu

It is well known that college students lack practical engineering experience. It is important to strengthen the practice of design thinking and the ability to problem solve. Hands-on experiences in engineering education are beneficial to increasing both learning and enjoyment during coursework. In order to promote student competence in innovative design, creative decision making, technical communication, and team work, a course of Introductory Mechatronics Creative Decision and Design Tool (IMCDDT) was established in 2011 at HUST, and a hands-on practice training project was integrated into IMCDDT. In the project, students are required to design a mechatronic device using the methods presented in lecture. The device competes in an end-of-semester competition. The project is important in both promoting enjoyment of competition and training students in hands-on competence. In this paper, we will describe the design of the mechantronic hands-on project integrated in IMCDDT.

14 - Making “Physical Chemistry” a more Interactive and Cooperative Experience

Michael Bredol and Thilo Harth

This contribution reports on a systematic effort to exploit hidden resources in an “Advanced Physical Chemistry” course in order to make them available for students needing more help than on average. The module is placed on M.Sc. level in an international programme and thus contains students with quite diverse cultural and language backgrounds, as well as diverse specific skills from prior studies. Several instruments like cooperative exercise platforms, bonus systems at examination time, inclusion of students in the selection process for the module contents, or the use of interactive graphical software have been tested in a coordinated way over three years to assess the influence on learning behaviour and cooperativity among the students. The project was embedded into and funded by a broader initiative on university level addressing continuous change and improvement in teaching methods. New ideas in the field of engineering education like bonus systems, supporting key competencies and collaborative learning settings play a significant role in this programme.

4 - Student Perspectives of Practical Work done in a Laboratory – a Case Study from Logic Design III

Nicolaas Luwes and James Swart

Official accreditation bodies regularly review engineering education programmes to ensure that they adhere to the high standards set forth by the Washington, Sydney and Dublin Accords. These programmes must enable student to demonstrate important graduate attributes such as problem solving, being technologically literate and technically competent, which can be assessed within a laboratory environment. The purpose of this paper is to present student perspectives of practical work done in a Logic Design laboratory with regard to it being enjoyable, beneficial, challenging and relevant to the theory covered in a classroom. An exploratory study is employed along with descriptive statistics involving quantitative analysis of the collected data. Results

indicate that the majority of students (45 % strongly agree: 45 % agree) enjoyed the practical work, while many (56% strongly agree: 32% agree) felt that it was beneficial in terms of helping them to understand and apply theory in solving engineering related problems. The majority of students (25 % strongly agree: 47 % agree) further felt that the practical work was challenging, while (51 % strongly agree: 40 % agree) agreed that it was relevant to the theory covered in the classroom. However, (41 % strongly agree: 11 % agree) of students did indicate that they do not want to submit their practical assignments online. These student perspectives suggest that students are fusing their theoretical and practical knowledge, experiencing a measure of satisfaction as they demonstrate the acquisition of important graduate attributes.

58 - Experimental Centric-Based Instructional Pedagogy

Peter Bofah and Mohamed Chouikha

This paper describes a project of cooperation among thirteen (13) Historically Black Colleges and Universities (HBCU) electrical and computer engineering programs. The intent is to develop an HBCU Engineering Network (HBCU-EngNet) with focus on the development, implementation, and expansion of an Experimental Centric based instructional pedagogy (ECP) in engineering curricula used in these HBCUs. The outcome of such cooperation is nothing less than the production of a larger number of better prepared African American engineers, as well as other students who have a better public understanding of technology and its role in (science, Technology, Engineering and Mathematics (STEM), education and policy. The ECP is being implemented at the various HBCUs to allow students of varying learning styles the opportunity to learn at their own pace and in their own environments, by providing them an alternative way to acquire technical skills and knowledge both in the classroom and outside. We describe the various learning modules developed by the HBCU networks covering courses in Electrical and Computer Engineering (ECE) first two years curriculum: Introduction to Electrical Engineering, Electric Circuits and Lab, and Electronic Circuits and Lab.. We build on the ECP courses that have already been developed, evaluated, and adopted at Howard University and Morgan State University, with an established National Science Foundation (NSF) funded Engineering Research Center (ERC) at Renssalaer Polytechnic Institute (RPI).While these courses were developed using the Mobile studio, the new ECP based learning modules have been developed using the Analog discovery boards. Faculty members of each member HBCU shares their labs and class activities through a set of hands-on face-to-face training workshops that is held at Howard University campus in the fall and in the summer. We have also conduct bi-weekly online training workshops, meeting with guest speakers' talks via webinars and video conferencing tools. We also have online site to host documents, activities, online resources and best practices. We will report on preliminary assessment results of student learning and conclude on describing lessons learned and the next steps of this project for improvement.

55 - Effectiveness of Student- and Professor-Centered Learning in the Geotechnical Engineering Introductory Course

Dunja Perić, Marta Miletić and Mladena Miletić

Identifying effective learning and teaching styles in engineering education is challenging because many students lack systematic background knowledge, which adversely affect their enthusiasm and motivation for learning. Presently, there is a variety of methods that professors and instructors utilize in order to help students learn. Geotechnical engineering is a unique discipline in civil engineering that poses additional challenges while providing opportunities for development of more effective teaching and learning strategies. Therefore, a study was conducted to assess the effectiveness of currently employed student-centered (SCL) and professor-centered learning (PCL) methods. A hypothesis was made that SCL is more effective than PCL. This hypothesis was tested and confirmed by analyzing assignment grades requiring SCL and PCL. However, SCL in the analysis occurred only in a laboratory setting. Students indicated that having laboratory and recitation

sections offered in the same semester increased their motivation and enthusiasm. As a result of research findings, changes are being planned for future implementation. Specifically, the course is being significantly restructured so that SCL and PCL for each topic are better synchronized and interconnected. The goal of this effort is to better prepare students for SCL so that they infuse enthusiasm and motivation into PCL events. Additional modifications of PCL will include more referrals to laboratory experiments.

Parallel session TuB2

AOL, PBL and Quality Assurance 2

11 - On the Development of Statistical Models for Assessing Projects, Portfolios and Dissertations

Jim Freeman

Numerous assessment formats have evolved in higher education in recent years – many inspired by taskrelated activities in the workplace. Some are not new: at Masters level, the dissertation is longestablished, whereas at undergraduate level, the use of projects and portfolios is becoming increasingly fashionable. However, implementing these different forms of assessment is not always easy even when strict rubrics are enforced. As a consequence, double-marking is frequently used to offset the subjectivity of marks awarded. Unfortunately, this strategy too is not without its difficulties – as recent studies have shown – especially when there is fundamental disagreement between first and second examiners. Focussing on this issue of inter-marker conflict, a series of simple statistical models are developed to help assess how final marks might be more objectively determined.

6 - Fundamental problem-solving skills are found across the board in education:Are our power engineering students on-board?

A.J. Swart and L.E Toolo

Fundamental problem-solving skills are common to many disciplines and could be found to exist across the board in all forms of education, including Power Engineering. Industrial Projects IV is a compulsory capstone module for students enrolled for the postgraduate Baccalaureus Technologiae (BTech) in Electrical Engineering (Power) in South Africa. This module makes use of project-based learning to prepare student graduates for further postgraduate studies in terms of Masters and Doctoral degrees. This module does not involve the physical construction of an electronic project, but considers case studies from Industry where million rand projects need to be implemented to solve existing problems which may include network, substation or feeder strengthening. The purpose of this paper is to assess a singular Industrial Projects IV dissertation with regard to project-based learning principles where fundamental problem-solving skills are involved. These skills include identifying and understanding a problem and developing and evaluating alternative solutions. An illustrative case study is used where qualitative data is analysed in terms of a singular Industrial Projects IV dissertation. Quantitative data is also presented, in the form of the final dissertation grades for all Industrial Project's IV students for 2014 which is an indication of whether they successfully achieved the fundamental problem-solving skills. These results suggest that not all engineering students mastered these skills, leading to the conclusion that not all engineering students are on-board when it comes to problem-solving.

93 - The Role of Marketing Strategy Simulation in Assurance of Learning

Maja Martinović, Ana Kuštrak Korper and Martina Čaić

In this paper the comprehensive case study will be presented which illustrates how business simulation can be used to augment learning and how it can contribute to many of assurance of learning requirements. There are three approaches to achieving knowledge integration in marketing strategy simulation courses: theoretical, applied, and practical. Simulation enables students to build the practical integration skills in a risk-free environment so that they can make better decisions in their real business environment. The paper will also discuss how distance learning pedagogies can actually improve classroom teaching. It is clear that no single assessment tool can fully meet the assessment requirements of either a course or a curriculum. Paper will illustrate an assortment of enhancements and assessment tools that can expand learning opportunities and provide a variety of feedback information about students' knowledge, skills, and reactions to various market challenges. It will display the process of measurement methods and rubrics selection used to measure student outcomes, as well as the process of setting the acceptable results. This paper will present the approaches to "closing the loop" for several learning goals: knowledge in new and unknown circumstances through conceptual understanding of marketing strategy; capacity of critical and analytical thinking; usage of new technologies; oral and written communication skills, and student work in teams.

159 - Professionalism and Ethics in Engineering Education and Research: Issues of Skills Development and Future Employability

James Uhomoibhi and Maragaret Ross

In preparing students for today's employment, in addition to their technical and digital skills, there is a need for them to understand and develop professional skills. Students should be made aware of the role of their appropriate professional body, and be encouraged to become involved with its activities. All of the professional bodies have a Code of Conduct, which can be used to discuss professional practice. Various mini case studies to illustrate this will be included in the paper, which can and have been, adapted to students on different technical courses. Examples from the news can be used to further illustrate both ethical and legal issues, as students need to be aware of these both for their own sake and that of their employer's. Examples are given in the paper. In addition, the need to develop the softer skills, particularly presentation skills, that are so important to the initial employability and future promotion of students, are discussed. The issues of linking presentations with other topics, to overcome the reluctance of students, are reported. These include students working in small teams and with weekly feedbacks by one member of the team in turn; providing confidential feedback of presentation style. The understanding of these professional skills is not only important for the students' future employer, but also for their own employability and their future life.

193 - A Pragmatic Teaching Methodology in a Final Year Module in Engineering Education

Esther T. Akinlabi

Teaching can simply be referred to as an act, practice or an exercise of exchanging ideas or principles usually by an authority unto the person(s) being taught. The author believes that teaching can also be referred to as the process of imparting knowledge and skills to students or learners. This process may involve the activity of educating and instructing which often time has a formative effect on the mind, character and physical ability of a learner. For this act to be effective, it is expected that a teacher will employ pragmatic teaching methods to drive his/her point home to ensure that the students acquire the requisite learning and thereby imparting the lives of the learner at the long run. This paper reports some pragmatic teaching practices that have been

employed in teaching a final year module course in an Engineering Faculty in South Africa. In addition, the feedbacks on how the students felt about the teaching methodologies employed were received and analysed to further improve the teaching practices employed. Some of the teaching methods introduced to the students over a period of time include the use of relevant PowerPoint slides, video, industrial visits, show casing of prototypes in class, brainstorming sessions in class and once in a while have a class in a relaxed atmosphere for example under a tree with a good shade. From the feedbacks received from the unanimous teaching evaluation questionnaires analysed, it was revealed that all the students either agreed or strongly agreed that the teaching and learning materials and the methods employed have supported and facilitated learning in the module during the course of the semester.

Parallel session TuC2

Globalization and Cooperation in Engineering Education

28 - Quality Matters in Projects with Turku University of Applied Sciences

Timo Vaskikari and Kristiina Meltovaara

Nowadays it is quite normal to teach students with projects from a real work life. Both sides win, students will learn how to handle real life projects, and vice versa, companies will get quite cheap work labor with the newest knowledge on IT and enthusiasm. Engineering students in Turku University of Applied Sciences have practiced many years this kind of learning in engineering education. However some problems do exist, which have to be taken into consideration. In many cases it can be hard to get suitable projects from the industry at the right time. And as well as this , when companies have suitable projects there is no time for students to take part in these projects, because they are rushed to complete their theoretical studies. In this paper typical quality problems between companies and Universities of Applied Sciences are discussed and some conclusions are drawn and practical innovations are suggested.

174 - An Inter-campus, Multi-disciplinary, Industry Sponsored Capstone Design Project on VTOL

Shih-Liang Wang

In the past three years, the Boeing Company has sponsored a multidisciplinary, inter-campus senior capstone design project to design a futuristic vertical take-off and landing (VTOL) aircraft based on probable technologies available for production in 2040. Each year, students from Iowa State University (ISU) and North Carolina A&T State University (NC A&T) team together to work a on a different VTOL project. Each year, two collaborative teams of students from ISU and N.C. A&T are formed to compete. Each team has 7 aerospace engineering seniors from ISU and an equal number of students from N.C. A&T (from three departments: mechanical engineering, industrial engineering, and electrical engineering). Students gained valuable experience through this challenging project.

60 - LINC Project for Enhancement of Industry-University Cooperation in Engineering Education in South Korea

Euy-Soo Lee, Juntae Kim, Hae-Jong Joo, Byung-hoon Jeon and Chee-Sun Won

South Korea has achieved a rapid economic growth over the past 40 years and engineering education is evaluated as contributing greatly to such economic growth of the country. However, the engineering education of the South Korea is now experiencing many challenges. Typically, there is unbalance between engineering manpower and its industrial demand, top students tend to avoid choosing engineering, and companies raise problems on engineering curricula's failure to reflect latest technologies. In this paper, we present one of the government's major projects related to engineering education - LINC (Leaders in INdustry-university Cooperation) program which was launched in 2012 to enable university education to respond effectively to industrial needs through industry-university cooperation. Dongguk University was selected for this program since 2012. Through Dongguk University's example, we will introduce on the establishment of industry-university cooperation-friendly university system and the construction of components for the improvement of education.

38 - A Model for Global Collaborative Engineering Education in Product Data Management

Emmanuel K. Glakpe

Over the last decade, five universities around the globe have been collaborating in the teaching of a course on product data management through design. The universities are Howard University and Virginia Tech in the USA, ITESM in Monterrey Mexico, Technische Universitat Darmstadt, Germany and Shanghai Jiao Tong University, China. In addition to introducing the students to working across continents on a design project in global teams, it brings the students together to understand each other culturally and to bring this union to bear on the major engineering design project which is constrained to satisfy customer needs in different world markets. The course is taught under the global umbrella of the Partners for the Advancement of Engineering Education (PACE) that has generously provided some resources to enhance the delivery of the course. In this paper, a general description and history of the course is presented followed by specifics related to the planning, organization and conduct of the single semester course. The resources for the course are described in addition to the conduct of the course over the thirteen week semester period. Examples of students' work are presented in the paper. The paper concludes with achievements, challenges from the collaboration and provides recommendationsfor the enhancement of the course.

160 - Teams in Kenyan Engineering Education

David M. Bowen

Engineers are a critical human resource as Kenya pursues stated national goals, including the desire to achieve Newly Industrialized Country status by the year 2020. The effectiveness of Kenya's engineers and their ability to work together to design and actuate complex systems will play an increasingly significant role in Kenya's abilities to be self-sufficient and to face global competitive challenges. Consequently, engineering education and practice is of the utmost importance for Kenya's development. Today's professional engineering environment is characterized by increasingly complex systems, accelerating rates of technological change, global competition, and ever decreasing design-build cycles. To thrive in such an environment, engineers need abilities that complement traditional technical skills. Increasingly engineers need to be proficient with non-technical skills including communication and the ability to work in team environments. Accordingly, 'ability to work in multidisciplinary teams' is an ABET requirement for engineering graduates, and there is significant effort to instill such skills in ABET accredited schools. In this study we report the results of a qualitative study utilizing interviews of engineering faculty at Kenyan Universities that offer degrees in engineering. Topics covered include educational and professional background, including working in and/or managing engineering teams, and use of engineering teams in Kenyan Universities. The interviewees indicate that they believe that team skills are valuable for engineering professionals, however little to no formal programs exist for generating these skills in Kenyan engineering students. We conclude with a discussion of the necessity of team skills in the emerging engineering professional environment, and suggestions for inclusion of team skills in Kenyan Engineering education.

Parallel session TuA3

Innovation

20 - Inspiring Innovation

Mahbub Uddin

Innovation is the agent of change. It is the catalyst for continuous creation of new products, processes, services, and businesses. This paper articulates the taxonomy of inspiring students to engage in innovation journey. It provides a road map of how to awaken passion for innovation, develop and nurture mindset for innovation, overcoming barriers for innovation, understanding the thinking tools and characteristics for innovation and experiencing through the innovation journey.

66 - Innovation in Microelectronics Assembly Technology Education

Ivan Szendiuch and Edita Hejátková

This paper deals with innovative education programme in the microelectronics technology area, containing modern technologies of electronic packaging and interconnection. It is applied at Faculty of Electrical Engineering and Communication in Brno University of Technology. The subject "Modern Microelectronics Technology" gives the fundamental knowledge and skills about "Electronics Hardware" in booth Bachelor´s and Master´s degree program in particular. The content of the lecture is in accordance with the global development and is coordinated with programmes at various universities worldwide. A new idea, and at the same time the main objective in this area is to achieve still closer contact of the University with the industry in terms of technological integration. Lectures and laboratory curricula are described, as well as the supporting project, which is implemented in the form of an integrated circuit, by students in team work organization. Practical training in the microelectronics laboratory forms a very important part of the learning process, which is positive valued by students, and was also awarded by the International Microelectronics Assembly and Packaging Society. The laboratory is based on low cost no-vacuum thick film technology, which allows students to realize various electronics components and also their own integrated circuit. Therefore, the main emphasis is on the acquisition of practical skills and abilities. It also increases students' motivation and their active approach to study. This paper describes the structure of the course and includes also some experience of teaching.

105 – Innovation Lessons to Apply to Engineering Education

Barry A. Benedict and Lilia A. Abron

Increasingly, engineering graduates are expected to contribute to innovation within the companies or agencies for which they work. Engineering education needs to begin preparing graduates to contribute and succeed in that environment. Many of the most pertinent findings considered for curriculum inclusion originated in other disciplines. Several possible approaches are presented in this paper with discussion of appropriateness and ease of adoption in the curriculum. These concepts will be applied to a senior design capstone course, while also describing how they apply to PEER Consultants, P.C. Among considerations are teams, organizational structures, space, and finding others. A number of techniques for enhancing team performance and innovation are presented, including ideation, design thinking, liberating structures, and brainstorming. Team member accountability is a key element, and team formation should not be random. Use of other organizations, both within and outside the university, is discussed as possible support. The value of interdisciplinary collaboration is noted.

47 - Continuous Quality Improvement of Leadership Education Program through PDCA Cycle

Tomoko Maruyama and Masahiro Inoue

The reinforcement of quality assurance system in university education is in great demand. With the goal of quality assurance of a class curriculum, we applied the Plan-Do-Check-Act (PDCA) cycle on leadership education on graduate students of engineering, resulting in seven years of continuously improved quality of the education program in which students achieved their learning goals. The traditional leadership education only gave students knowledge regarding leadership in the form of lectures. Therefore, how to apply this knowledge through students' action has been a big issue for them. To improve leadership ability of students we introduced leadership education program which integrating knowledge, simulated experiences, and real actions. This leadership education program was conducted in the Masters program at the Shibaura Institute of Technology's Graduate School of Engineering and Science between 2008 and 2013. We measured the extent to which students achieved their goals, combining diagnostic, formative, and overall evaluations. With evaluation results of clarified learning outcomes, a PDCA cycle was repeated in order to improve quality of the education program in three stages. We validated that this cycle led to the achievement to produce effective leadership actions of students.

Parallel session TuB3

Information Systems and Information Society

53 -Virtualization of Laboratory Education in Network Security Engineering

Antti Hakkala and Seppo Virtanen

In this paper we discuss the benefits of virtualization of network security education environments in university level information security education. We approach the topic with regard to student learning experience, teaching staff workload, learning environment engineering, and facility use. Virtualization technologies have advanced significantly in recent years, making the switch to virtual environments possible. This paradigm shift from physical computer laboratories to virtual learning environments has gained momentum also in higher education, where large lab rooms full of computers are still an everyday reality for students. With virtualization, these computer classrooms can be repurposed as multifunctional facilities. Practical benefits for virtualization include better use of facilities, cutting costs and providing added value to both students and the faculty. Our goal is to take this emerging transformation to its logical conclusion with a fully virtualized network security education environment, with a separate network infrastructure from production networks. This environment is designed to allow students to use their own devices when doing lab exercises, with support to most popular operating systems, making it possible to arrange lab sessions in a regular classroom, or anywhere a suitable Internet connection is available.

82 - Defining and Measuring Key Expertise Areas in Information Security for Engineering Students

Antti Hakkala and Jouni Isoaho

In this paper we discuss what kind of and what level of requirements on information security knowledge the emerging information society poses for its citizens. By defining key topic areas of interest and mapping out essential skill sets and knowledge areas in information security for engineering students in relation to these requirements, we start to assemble a framework which can be used for developing information security education. First, we divide the field of information security into subcategories and map them to different learning profiles, based on different levels of required competence. With the help of an online learning environment, we analyze preliminary results on measuring students' expertise and development in lower expertise levels in the context of an entry-level course on information society and cyber security, where we piloted the framework that we have developed. We discuss the practical arrangements of three online exams with the goal of efficiently measuring student knowledge on information security, and present preliminary data on learning results using the first version of this framework.

86 - Management of Parallel Change Request Processing

Branko Sinković, Andrea Budin and Gordana Barić

Change requests are common part of the software product lifecycle. They can be initiated by end users because of legal changes, business process change or improvement as well as system errors, and by developers or system designers. If the support team should resolve requests sequentially, there would occur a lag time while waiting for the end users' feedback, therefore the support team members are working on the multiple requests in the same time. As the number of requests executed in parallel grows, the time requested to switch between the tasks becomes significant.

48 - Information System as a Management and Communication Device for Scientific Research at the Moroccan University

Youmna Elhissi and Abdelkrim Haqiq

In a context of E-Governance and modernization of higher education, the Moroccan University is facing new challenges, such as: - Orientation, development and promotion of scientific research that meets the needs of the socioeconomic environment and therefore affects the lives of citizens. - Developing the culture of communication and information by ending practices that limit the dissemination of information. Moroccan strategy for the development of higher education has focused all its projects on the use of new technologies for the management and structuring of research, and the promotion and enhancement of its activities. To this end, the establishment of an information system for the management and communication of research in the university can organize all the research activities, structure research units on an administrative and financial sides it can also communicate its work to enhance the sharing and open a window of partnership with its socio-economic environment. This work aims to develop an information system for management, information security and communication research in the Moroccan university. This system will allow collecting, classification, processing and disseminating information related to scientific research at the university in order to organize and structure all its activities. It will also enable all university's actors to use a digital workspace to access and share information, and therefore interact and get involved in the promotion of scientific research at the university.

Panel Session

157 - Ideas to Big to Stay Small: Two cases of tech startups in Croatia with Double Bottom Line Impact

Tina Lee Odinsky-Zec

Purpose – The purpose of this panel is to illustrate the trajectory of ideas that are conceptualized for greater impact beyond their borders. The cases originating from Croatia, one of Teddy the Guardian, a high tech teddy bear that aids in child patient diagnostics and the other, Serwantess, a device that improves quality of life for home-bound patients are examined as both have customer markets that extend well outside their country of origin. Design/methodology/approach – Two enterprises with innovations in healthcare are explored through in-depth interviews with their founders as well as data collected from secondary resources. Their stories are unpacked using Isenberg's Domains of the Entrepreneurship Ecosystem as a framework. The startup ecosystem assessment is seen from their perspective to reflect the accelerators and inhibitors to their growth and development. Findings – The two cases showcase the opportunities and threats of big ideas coming from small markets. Lessons can be learned on how to create an environment that assists tech startups in navigating multiple stakeholders. The double bottom line impact includes social, they are improving the care of patients and financial, whereas and generating investments and sales internationally. Originality/value – This panel provides real value by focusing on two emerging startups that launched within the past five years with rapid traction made possible by focusing on solutions to universal problems.

Parallel session WA1

New Teaching Methods 1

10 - Integrated Teaching Methodology of Programming Logic and Statistic

Eduardo Oliveira Teles, Hugo Leonardo Deiró de Souza and Dante Augusto Barone

The Programming Logic and Statistics are fundamental disciplines to performing tasks in the areas of Engineering and Computers. The development of skills in both areas contributes significantly to training professionals. As long as the Statistic allows to process data, facilitating their understanding, the Programming Logic organizes the implementation of activities/routines and helps in solving complex problems. The use of the R language of programing in the methodology presented in this work allows the visualization of data, and it was used for the integrated development of statistical calculations and graphics, working with the main topics of statistics and programming. This paper presents a methodology to teach Programming Logic and Statistics, in an integrated view, using the R language with a case study focused on monitoring energy consumption. The case study shows how available data at the Educational Institution have been studied, allowing the contextualization and better learning of the subjects covered. This model can be used in other disciplines.

16 - Engaged STEM Learning Using Catapults

Peter Willmot and Anthony Sutton

This paper describes one element of a year-long module for mechanical engineering students that is designed to enhance student engagement and improve professional skills. This mini-project embraces the concept of 'enquiry based learning' within a challenging student-centered team project. The intensive and competitive project was scheduled early in the first semester as a vehicle to assist students to adjust to their new surroundings at a time when there were no other lectures or classes. The 160 strong cohort was divided into tutorial teams of 6 and started with a review of the mathematical concepts related to simple kinematic systems and the laws of motion. Teams were then exposed to designing, manufacturing and testing a floor mounted catapult and competing to out-perform others through their efforts. Strong bonds became apparent among team members and the willingness on the part of many was shown to work beyond normal class hours were observed because of the exciting and motivational challenge. An online survey provided evidence that, in addition to substantial social benefits, the exercise proved a powerful vehicle for enhancing practical understanding of fundamental mechanics that had been revealed as generally lacking in freshers.

80 - Creation of a Collaborative Study Community in Engineering Studies

Sakari Lukkarinen, Jaana Holvikivi, Peter Hjort, Mikko Mäkelä and Minna Lakkala

This paper describes a novel course structure at the beginning of engineering studies. The aim of the course was to integrate new students into the study community by keeping them tightly together in one classroom during the first eight weeks of studies. The idea was based on project-based learning that has already been introduced at many universities. However, the course did not revolve around one single project, but consisted of several small team assignments. The paper is a case study that describes the course and its findings, comparing the situation with previous years' experiences that have been documented in several earlier studies. Feedback and notes were collected regularly during the course. Student surveys after the course indicated a high student satisfaction.

78 - Students' Perceptions on Collaborative Work in Introductory Programming Course

Teemu Rajala, Erno Lokkila, Rolf Lindén, Mikko-Jussi Laakso and Tapio Salakoski

Pair programming and other forms of collaboration are generally considered useful for learning. Still, as educators and researchers, we should also pay attention to students' opinions on the collaboration and the effects it may have on the quality of their work. While redesigning an introductory programming course in our institute we converted half of the lectures into automatically assessed interactive tutorials with heterogeneous set of exercises. Students completed the tutorials in collaboration, with two students working on one computer. In this paper we first present the pedagogic background for making the aforementioned redesign choice. Next, the technical implementation of the tutorials and pair work is described. At the end of the course, a comprehensive survey was given to students (N = 153), asking them to describe whether they preferred collaborative work over working alone, how effective they found the collaborative work, and what kind of factors they think influence the effectiveness of working with peers. Based on the results, students generally were in favor of the collaborative work and in their opinion the greatest benefits of pair work were the knowledge sharing, improved learning, faster problem solving and learning interaction skills.

168 - Addressing Learners Challenges in Open and Distance Education with the focus of literacy and use of ICT Tools, Case Study Focused on the Open University of Tanzania

James Uhomoibhi and Juliana S. Kamaghe

Due to budgetary and time constraints, the materials science basic course for non-majors is offered at many institutions in the format of lecture only. In order to enhance the learning experience of the students, an interactive virtual lab was developed to enable the students to have a hands-on practice to complement the lecture. Traditionally, laboratory instruments that are too expensive and, at times, hazardous (such as X-ray diffraction), were unavailable for educating most engineering students. In the current project, funded by Hewlett-Packard and NSF, simulations that use game-design approach, were made the experiments broadly available to large classes. To make the lab even more affordable, it was developed to run on simple laptops. It is widely and freely distributed around the globe. Assessment of the virtual laboratories has been conducted at several institutions in the US and abroad. It included diverse populations in a variety of universities and community colleges with positive results from both learning outcome and student attitude. The laboratories also proved to be successful for demonstrations and hands-on recruiting events for middle and high school students.

Parallel session WB1

Distance Learning, E-learning and Blended Learning 2

173 - Usability of the UML4ODP for a Technological Specification of a Distributed Teaching Embedded Systems Environment

Mohamed Mhamdi, Hamadou Saliah-Hassane and Rafik Braham

The present work is part of the research that we have been working on for many years and which concerns the design and development of remote laboratory systems (more specifically about distance Lab Work). In response to the resolution of problems related to the distance Lab Work, we have proposed in our previous works the specification of a distributed environment that will help to generate distance Lab work Supports for teaching embedded systems. This has been called "a Tele-LabWork System Environment Generator for Teaching Embedded System" or "TeleLWS_EG", for short. The ODP- RM model (Open Distributed Processing - Reference Model) proposed by the ISO (International Organization for Standardization) provides five viewpoint languages for specifying open distributed system. The viewpoints are: enterprise, information, computational, engineering and technology viewpoint. The five viewpoints of the RM-ODP model were used to specify the architecture of the TeleLWS_EG system. The instantiation of these viewpoints on the actual standardized educational technologies has allowed us to prove their existing gaps. In particular, we found the absence of a meta-reflection on the life cycle of the learning system and consequently the non-inclusion of the business and technological viewpoints. The technology viewpoint in the RM-ODP model defines the environment of implementation and deployment of systems using the best current technologies, standards and products. In this paper a combined use of RM-ODP and UML4ODP profile will enable us to specify the technology viewpoint of the TeleLWS_EG system.

111 - E-Teaching and Digitalization at BME

András Benedek and György Molnár

Our research focused on the results of a project development entitled "E-Teaching Culture and Digital Content Development at BME" that took place between 2013-2015. It aimed at developing content, methodologies and services related to the competitiveness of higher education, structural changes coming from the Bologna Process and meeting the challenges of knowledge-based economies. The relevant fields included updating presentation techniques and instructional methodology. These areas were particularly important from the viewpoint of the topic. We intended to present that visual learning may provide opportunities to use parables that are able to improve the efficiency of human learning. This learning process is currently based on traditional verbal communication and as such hindered by time constraints and information pressure. Developing curricula presented challenges in the fields of digitizing, multimedia editing and on-line publishing. Meta-data structure, SCORM conversion and formats matching the relevant criteria were defined as required by e-learning. Empirical analysis was performed on the use and efficiency of the new SCORM learning materials. Thus, the results of the research pointed out a number of good practices. These can be used as "working" innovative solutions that take into account and adapt to the learning habits, attitudes, new student roles. These solutions also adapt to the expectations of the higher education students.

2 - Advancement in Educational collaboration – web hybrid applications in blended learning

Hrvoje Jerković

New and emerging web application and services are offering many new exciting possibilities for education in distant and blended learning modes. On other hand universities and other educational institutions often develop their educational activities around several basic e-learning tools contained in Learning Management Systems (LMS). Learning Management Systems are standardized information systems for management of courses, e-learning content, users and tools. Although rich with tools and different add-ons they still don't allow users and administrators to fully integrate LMS content and functionalities with third party systems. Current architecture of most used LMS only partly support integration with different tools for authoring, sharing, decomposition, reuse, querying, publishing and other similar applications. This paper explores e-learning possibilities offered by cloud based web hybrid applications in elearning environment and offers proposal for future cloud based hybrid system.

116 - Addressing Learners Challenges in Open and Distance Education with the Focus of Literacy and use of ICT Tools, Case Study Focused on the Open University of Tanzania

Juliana Kimaghe and James Uhomoibhi

Information and Communication Technology (ICT) is playing a fundamental role in open and distance learning (ODL) to meet the necessities and opportunity of the learners' in large scale. The challenges, which faces the students who are enrolled in university with ODL system is ICT literacy at large. ICT is a tool, which is used to help learners to attain their goals, and has been the major factor for providing high quality of education in universities. It is difficult to carry out the same using any usual institutional scheme due to its partial resources. ICT has various proven tools and technologies to meet the requirements of a learner in different skills. The question is; do the students know how to access the contents in online system instead of using other form of study materials?. This paper analyses what are the challenges that learners are facing and ways that will be able to solve the problem of ICT tools literacy. In addition, ways on encouraging the learners on the use of ICT tools to improve the quality education

Parallel session WC1

Robotics

23 - Global Collaborative Senior Project: Engineering Design of Robot Aesthetics

Annan Dai, Wenchang Zhang and Yiming Rong

This paper presents a show case on aesthetic robot design coupled with technical function constraints and engineering performance analysis method. A global team of engineering students from US and China worked together to improve the robot aesthetic design as their capstone design project, closely working with the industrial sponsor. First a project goal is determined based on robot aesthetic analysis and measures defined. Decision matrices are used to evaluate the aesthetic satisfaction in both component and assembly levels of the design while the scores are assigned subjectively through panel discussion. 3D printing technique is used to get the physical models for rapid verification of the design and to facilitate the design evolution. Examples are given for robot component design as well as the over evaluation of the robot aesthetics. Cultural difference and project coordination is also discussed.

172 - A Gentle Introduction to Robotics Software Engineering Education

Birol Aygün

As robotics becomes increasingly important in technology and therefore in our contemporary society, engineering education needs to increase its offerings related to this new discipline. Since robotics involves topics from several branches of engineering and science, students in this branch need a synthesis of material and techniques from different areas. Our approach is to look at the project lifecycle in robotics software engineering education in the light of experience in existing branches of engineering and to focus on how a synergy can be realized to achieve success in educating students in this new discipline.

31 - The First Year Experience of Using LEGO Mindstorms Robots in the Tallinn University of Technology Outreach Program for Secondary and Primary School Learners

Kadri Umbleja

The number of secondary school graduates in Estonia has been dropping for some years now. Public universities are supported by the state according to the number of students studying. In that kind of atmosphere, all the universities are trying their best to attract potential students to enrol. Potential undergraduate students tend to think that engineering curriculums are too hard or they lack interest and understanding about the field. Therefore many young people prefer to enrol into more “softer” curriculums, but society still needs well qualified engineers, especially when the number of graduates is decreasing year after year. In order to encourage schoolchildren to consider career in engineering and raise their interest in technology, hands on programming workshop with Lego Mindstorms kits was developed as a part of an outreach program. The task of the workshop was to program a robot who follows a given line in competition against other teams. During the first year, almost 500 students participated in this kind of practical robotics lessons with ages 8 to 21. They were asked to fill out feedback forms. In this paper, the workshop structure and changes made to it during the first year of conducting the workshops are described. Students’ answers according to their gender and age are analysed. Also, reasons behind the success of this project are discussed.

43 - Undergraduate Curriculum in Robotics

Jau-Liang Chen

Robotics is a branch of mechanical engineering, electrical engineering and computer science that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing. It is difficult for mechanical undergraduates to fully understand and build up a real robot in a one-semester course. The goal of the course "Kinematics of Robotics" is try to let students know basic theory in robot and practice of robotics engineering. This paper shares the experience in teaching this course. In the beginning of the course, students will be introduced to the foundational concepts of robotics such as kinematics, dynamics, control, and programming. Then, students' knowledge of sensors and motors is integrated with programming logic as they perform complex tasks using LEGO® MINDSTORMS® NXT robots and software. Through two lab work assignments and final competition, students will be familiar with the steps of the engineering design process and come to understand how science, technology, mathematics and engineering—including computer programming—are used to tackle final competition and help people solve real problems. The most convincing achievement of this course is that one group of students attended the 2013 World Robot Olympiad (WRO) college category (Mars Colony) competition on 15-17 November, 2013 in Jakarta, Indonesia, and won the first place.

Parallel session WA2

Best Practices in Engineering Education and Research 3

100 -Toward a more Practical Engineering Curriculum

Klaus Wuersig

When students matriculate in the Engineering department at the University of Pittsburgh, they will be required to do a Freshmen project as a team member, in the first semester. This usually requires a fair amount of practical knowledge. However is it enough to realize, what are the practical implications in every course area? It is kind of a shock to realize that many students have no idea what a resistor looks like, what happens when a capacitor charges, why Thevenin's Theorem is so powerful, why a digital counter operates as it does and one could go on and on with dozens of other examples. Starting in the fall semester of 2014, teams of 2 or 3 students are required to present to the Professor a practical example of a circuit or theorem discussed in theory. It has to be on a breadboard with its own on board power supply, has to show in certain cases output using LED's, and requires a one or two page explanation of the theory involved. 10% of the semester grade will be dependent on a proper presentation of a practical example and if a presentation is not forthcoming a group of students will forfeit the 10% of their grade. After their sophomore year students are urged to sign up for the coop program and a majority of them do. Here they obtain valuable practical work experience during their semesters on the job, most often are hired by the company they are working for as a student and get a good wage for their efforts. The above of course is based on an Electrical Engineering program but can be just as well formulated for any other Engineering discipline, The extra work involved in monitoring the simple projects of the student groups will show up in a better understanding of the theory of each course

70 - Undergraduate Capstone Course for Mechanical Engineering

Shean-Juinn Chiou and Jhy-Cherng Tsai

To bridge the gap between mechanical engineering education and industrial demands, a capstone course, Mechanical Design and Practice, has been offered since the academic year of 1995 to undergraduate students majoring in mechanical engineering. The course aims to cultivate students' creative design abilities and improve their prototyping experience. This course is currently organized as a series of Mechanical Design and Prototyping Projects modules in which junior and senior students apply previously achieved knowledge, skills, and experience to engineering problems. In addition to theoretical analyses, these projects emphasize hands-on practice in mechanical design and prototyping. The current course design is based on almost 20 years of teaching experience and feedback from students and their parents. This paper describes the course design and its rationale. Furthermore, this paper elaborates on the course details and its implementation.

170 - A National Educational Center on Machine Tool Technologies

Jhy-Cherng Tsai, Shean-Juinn Chiou, Ming-Chyuan Lu and Jau-Liang Chen

The machine tool (MT) industry of Taiwan is important as it is ranked the sixth in the world. While there is a long-term and continuous need of engineers in this industry and it is difficult for an institution to cover all fields in MT technologies, this paper describes the development of a nation-wide educational resource center for this purpose. The National Education Resource Center on MT Technologies at National Chung-Hsing University (NCHU ERCMT) is an academy-industry alliance aimed on MT technologies and located at NCHU in Central Taiwan. Members of this center consist of universities, with major efforts in MT related area, across Taiwan as well as industrial companies. Mission of this center includes developing curriculum on MT technologies and shared coursework across institutions as well as organizing nation-wide/international seminars, student project competition and student summer internship. The curriculum includes a series of core and advanced courses, seminars as well as hands-on laboratory courses and field trips. Due to limited industry-experienced faculties in universities, several courses are lectured by senior engineers and managers from near-by MT industry and research institutes. Some others, in particular laboratory courses and field trips, are supported by research institutions and companies through industry-academy alliance. Lectures of core course are broadcasted to classes at partner institutions through network. Seminars in MT technologies, including two to three international seminars each year with invited speakers from overseas, are open to public including near-by industries. A nation-wide student project competition, funded by industry, in MT technologies is held each year that encourages students put more efforts on hands-on practice with knowledge learned from the curriculum. Funding of this competition from industries are over NT$2,000,000 (about US$700,000) per year. Summer internship is also promoted under this center that provides a platform for industry-oriented practical training for students from partner universities. Although this center was originally supported by the Ministry of Education, matching funds and academic-industry cooperated research project from member institutions and industries enriches this educational center to strengthen the relationship between academy and industry.

64 - An International Action for Cooperation in Engineering Education between Spain and Morocco

Eduardo Montero, Fatima E. M. Alaoui and María Jesús González-Fernández

The University of Burgos in Spain has launched, since 2012, an institutional development cooperation for education programme which involves three types of actions. First, staff interested in driving academic research and studies in this field. Second, students interested in developing their final degree-work in developing countries, with the help of some NGO. And third, to staff with the aim of developing institutional training programmes with higher education institutions in developing countries. This paper presents a case study of the cooperation for education programme developed between two faculties of engineering in Burgos and Morocco between 2011 and 2015. Results in terms of activities developed, participants and institutional issues are presented. The relation between research and education will be highlighted as a key factor to carry on such cooperation action. Challenges and pitfalls of the exchange of students and lecturers for learning purposes, teaching courses on engineering education innovative methods to staff and mutual benefits for future research and cooperation for education are described. The experience has produced a multiplicative factor as new opportunities for cooperation have appeared.

Parallel session WB2

AOL, PBL and Quality Assurance 3

77 - Enhancing Student-Teacher Communication in Programming Courses: a Case Study Using Weekly Surveys

Erkki Kaila, Einari Kurvinen, Erno Lokkila, Mikko-Jussi Laakso and Tapio Salakoski

Though various techniques to improve the student motivation and learning performance in programming courses have been developed, the aspect that is often forgotten is the communication between students and teachers. Student feedback, if properly collected and analysed, can be used to encourage self-reflection and to collect important feedback on the course methodology redesign. In this paper, we present a redesign of an introductory programming course, with focus on improving the communication between students and teachers. For this, two weekly surveys were conducted: one after the lecture, and one after a tutorial session. Each week, the feedback collected was analysed and issues addressed in forthcoming lectures and tutorials. In the paper we discuss the process of designing the weekly surveys, the methods for analysing them and the changes made in the course design based on the surveys. Also, a collective analysis of feedback collected with the weekly surveys is presented. The results show, that continuous surveying is an excellent tool for tracking errors and issues in materials, and should be utilized whenever major changes in course methodology are made.

32 - New trends in Chemical Engineering Education: Personal Prospective

Mohammad Ahmad and Joseph Zeaiter

Chemical engineering teaching has evolved over the last 10 years with more emphasis on product development and process intensification. Sustainability is also becoming an essential part of chemical engineering where environmental, economic and social dimensions meet. An essential part of design now incorporates safety with Life Cycle Analysis (LCA). These changes are having major impact on the chemical engineering practice especially on biotechnology and related industries. In this paper, the new trends in chemical engineering education will be highlighted along with the different accreditation criteria in Europe, UK, and the Middle East which follows an American system. The differences between these systems will be highlighted and discussed in terms of profession requirements in these regions. It is worth mentioning that these regions' education systems and accreditation policies meet at some point especially when we are talking about multinational institutions across the globe.

34 - Students' Perception of Learning Facilitation during an Interdisciplinary Engineering Design Course – A Case Study

Martin Jaeger and Desmond Adair

Important engineering competencies can be developed within a Problem-Based Learning (PBL) environment. However, learning facilitation plays a major role in guiding students' learning towards the anticipated learning outcomes. The purpose of this case study is to analyze students' perception of learning facilitation during an interdisciplinary engineering design course delivered using a PBL approach. Based on criteria from a PBL inventory , students' feedback on their PBL facilitator was collected. The results show that students' project work led to overall positive learning outcomes. Also, students were found to show a strong preference to work as a multidisciplinary team as opposed to an interdisciplinary team. From the case considered here it can be in-

ferred that learning facilitators may have the potential to improve formative assessments (i.e. feedback) during students' project based learning. Furthermore, the connection of students' pr oject work with the anticipated learning outcomes may need to be reinforced. This is to ensure that students realize they are carrying out projects so as to learn pre-defined knowledge and skills.

35 - E-portfolio for Global Human Resource Development Program

Masahiro Inoue, Ichiro Sofue, Hiroshi Hasegawa, Atsuko Yamazaki and Anak Khantachawana

Japanese government selected 37 universities as the Top Global Universities among 758 universities in Japan in 2014 in order to enhance their international competitiveness. The government financially supports the selected universities. Shibaura Institute of Technology has been elected as a top global university. For the global human resource development program, we designed an e-portfolio system with three portfolio categories. The first category is the learning portfolio, which consists of rubrics as evaluation standards for measuring the degree of achievement of learning outcomes. The learning portfolio also provides a weekly-report submission site for students exchange and overseas internship programs. The second category is the carrier portfolio, which includes the Progress Report On Generic skill test (PROG test) as a means of generic skills assessment and reflection for students. Third category is the language portfolio. For the language portfolio we adopted the Common European Framework of Reference Languages: Learning, Teaching, Assessment (CEFR) and extended it to technical communication capability assessment. The e-portfolio system has been utilized to assess global project based learning courses, student exchange and overseas internship programs, and has proven to be effective in motivating students and improving the quality assurance of these educational programs.

99 - How Soft are the "Soft Skills" in Engineering Educations?

Jon Ram Bruun-Pedersen and Lise Busk Kofoed

Engineering education communities have long recognized that graduates not only need to poses technical knowledge in their chosen disciplines, but also need to be better educated in areas of communication skills, teamwork and leadership. Several studies mention these so-called "soft" skills as increasingly important for future engineers. Such skills include communication, cooperation, creativity, leadership and organization. For many years, the engineering educations at Aalborg University have been working with the Problem Based and Project Organized Learning pedagogical approach. An important part of the first year engineering curriculum is to learn how to make a project and how to work in groups. Part of the study is about getting these "softer" qualifications. Students are given the course "Communication, Learning and Project management (CLP)" and are at the same time working in groups so they can transfer theory into practice. In addition to their project, students have to make a "Process Analysis", which is an evaluation of their experience of the soft skills or process competences. Results show that "Soft Skills" are hard to learn.

Workshop

Teaching Technology Entrepreneurship at Engineering Universities – Experiences, Perspectives, Challenges, and Assessment

Sergej Lugovic

Technology entrepreneurship is a relatively new discipline, finding its place in curriculums of engineering universities around the world, in particular in the United States. It addresses how entrepreneurs capitalize on technologychanges. At the same time, it's relevant for the new technology-based firms (NTBFs) as well as incumbent technology-based firms (ITBFs) teaching students how to use scientific and technological knowledge in the real global marketplace.

Business and economics universities usually teach entrepreneurship. Today,however, for technology-dependent business operationsusingengineering and scientific advances, university research units and companies are exploring paths to capture researchresults and transform themto value for the customers.We will askthe question about importance of teaching entrepreneurship skillsto engineering students.

We can apply different teaching perspectives, and for the purpose of the workshop, we will use the following:transmission (subject content transmission), apprenticeship (behavioral norms and way of working), development (from the learner's point of view), nurturing (achievements comes from the heart, not head), andsocial reform (the impact on society) (Pratt & Collins, 2000). Another important related issue is what challenges universities face today, in particular,when teaching entrepreneurship to engineers.

We see radical shifts in the academic environment, where incubators and accelerators backed by financial industries and large companies are providing education around their products and services to deliver fast-track education.At the same time,new alternative models such a crowd-funding, share economy, and outsourcingareemerging. This leads to another important question, one that opens inquiry about assessment methods. Should we addresshow students perform in terms of financial and business results?Should we assess how they understand the body of knowledge?Should we observe how they behave and adapt in a real business environment, or should we evaluate their decision-making processes?

Workshop participants are invited to openly share their experiences and afterwards participate in a relevant conversation. The output of the workshop will be meeting notes, which will circulate to all participants with the option to publish them as a paper after post-workshop iterations.

Parallel session WA3

Modeling, Simulations and Optimization

52 - Enhancing Engineering Education by exceeding simple simulations using AnalogTM Discovery

Ben Kotze

Teaching and learning in engineering has developed remarkably over the past few years with the advent of educational technologies where more course material has been conveyed to students in a more effective and efficient way. However, challenges regarding improving throughput rates, enhancing student understanding of theory and selecting best practices still remain at Universities of Technology where a large part of the course material is taught in laboratories. The purpose of this paper is to introduce an approach which was adopted in a Control Systems Laboratory that not only improves student understanding of theory, but also increases the time-on-task which students spend on practical assignments. This is accomplished by the use simulations in MATLAB® where the results are verified by students using practical hardware equipment in the form of the AnalogTM Discovery equipment. Advantages of using this approach in contrast to using only laboratory simulations includes student satisfaction, increased time-on-task and improved cognitive skills.

40 - Modeling, Simulations and Optimization Based on Algebraic Formalization of the System

Natalia Serdyukova and Vladimir Serdyukov

The problem of improving algorithms, forecasting accuracy and quality planning system functioning, as well as evaluation of the effectiveness of its functioning, is one of the most difficult and important problems in many spheres of human activities, especially in the field of economics and finance, expert systems in General Theory of Education. The need for new mathematical methods is due to disadvantages of mathematical methods currently used for forecasting and planning in different closed systems such as financial and economic systems, system knowledge representation in an intelligent computer-aided training and control system and so on. The goal of this paper is to present new methodology of mathematical modeling allows one to get meaningful results in various fields of activity using the system approach and closed systems such as the modeling of economic phenomena and processes, expert systems in the General theory of education and to obtain a single complex of qualitative and quantitative indicators describing the studied process or phenomenon. The proposed in this paper methodology is based on the formalization of General Systems Theory using the methods of General Algebra and, in particular, the Theory of Algebraic Systems, Model Theory and Group Theory.

63 - Uniform Teaching of Network Simulation Skills in an Engineering Curriculum

Ethiopia Nigussie, Petri Sainio, Sanaz Rahimi Moosavi, Rajeev Kumar Kanth, Seppo Virtanen and Jouni Isoaho

Communication engineering technology is changing rapidly. The need for co-existing and seamlessly integrated heterogeneous networks and the currently evolving Internet-of-things technology are among the examples. As an educator, we have to make sure that the curriculum incorporates these changes. We present methods for successful teaching of network simulation skills which are under development in our Communication

Engineering curriculum. Simulation is one of the most important teaching instruments in engineering education. It is also a necessary working-life skill since in most engineering industries simulations are usually performed to proof the concept's and/or design's correctness before investing in the development of a product. The main principles of the curriculum are employing uniform and incremental teaching strategies with the aim of achieving the integrated learning outcome. The first step is choosing efficient simulation tools, which can be used in consecutive courses with few add-ons. The selected tools have to be closely similar with tools used in industries so that students can use the acquired skills directly in their future working life with minimum adaptation effort. Simulation models and exercises are developed through cooperation of the involved courses' lecturers and assistants. These ensure the uniformity of the teaching approach, progressive knowledge transfers and skills improvement.

129 - Portfolio Management Simulation as a Learning Tool

Igor Gvozdanović, Mato Njavro and Ivana Paradinović

Croatia's financial and capital market is relatively well developed in terms of providing investors and potential investors with access to trading domestically and abroad. The investing infrastructure is by and large in place and is aligned fully with the EU standards. However, most of the active and particularly would-be investors received none or very limited financial and investment education. This results in inferior financial skills and less than adequate asset allocation for the Croatian average investor. A cumulative effect of financially suboptimal literacy of investors has a nation-wide negative impact with less than efficient capital market being only one of its manifestations. With the surge of easily available portfolio management simulations such as Stocktrak, investment and financial concepts are much easier to grasp, understand and implement in the real investment world. Stocktrak simulation proved to be an invaluable supplement in raising financial literacy among finance students and those willing to manage their finances. The paper explores advantages of using the simulation as a supplemental learning curve and demonstrates its importance in dismantling cumulative investing illiteracy in Croatia, which is prerequisite for better asset allocation and the first step towards a more efficient domestic capital market.

Parallel session WB3

New Teaching Methods 2

56 - Enhancing Freshman Engineering Instruction with In-Class Interaction Systems and e-Books

Branimir Pejčinović and Phillip K. Wong

Electrical engineering students in our department take a year-long series of courses which introduces electrical engineering as a discipline and provides good grounding in engineering problem solving and programing. We have recently attempted to make the second course in the sequence more engaging by applying active learning techniques, including assigned reading and exercises prior to lectures, in-class exercises using a classroom interaction system, and programming exercises during lectures. Our results are mixed: while we think that students have learned more than if we had not used these techniques, we have not completely won over our students. While using an e-book was valuable, we believe that exercises within the e-book were not sufficient and their combination with in-class exercises did not provide sufficient training for students to feel comfortable with the programming. In terms of student problem solving skills, we continue to be puzzled by their difficulties despite their already quite extensive math background. There are also uncertainties with respect to our students' preparedness to take larger responsibility for their education as evidenced by their comments and the fact that reminders were required to keep students doing their assigned preparation work.

146 - Innovative Engineering Education through Modular Teaching with Emphasis on Design

Reza Nekovei

This paper presents an innovative approach for teaching upper-level engineering classes. It includes a faculty team where each faculty covers their area of expertise related to a semester long design project. While traditional lecturing has been shown to be passive and requires minimum student interaction. This approach facilitates learning by reducing inactive learning and replacing it with well-developed inter-related modules and hands on goal oriented design experience. This set-up reinforces learning and encourages the learner to think and get involved in his/her education. Each module is a self-contained unit dealing with specific concepts in the course. Modules are assessed with pre-test, post-test, and its contribution to the overall design project success. The integration of term-long design will emphasize inter/intra module concept understanding and improve student involvement. Additionally, this article discusses results obtained from two National Science Foundation (NSF) funded projects using this approach: one in robotics and another in Nano-electronics. The modular design method used in these two classes has proven to be an effective teaching method.

42 - Enhancing Student Performance through a Competitive Team Tournament

Arturo González and Enrique Covián

In some engineering subjects, the nature of the material requires a maturation time in the student's mind before being fully understood and the time constraints of modularization can become an impediment to the successful achievement of their learning outcomes. This paper presents a novel and efficient way of helping students to timely meet their learning outcomes by means of a Team Game Tournament. The principle behind a Team Game Tournament is that the success of a team lies on the success of the individuals composing the

team. Therefore, team mates help each other and study more than individually because they care for them and for the team. A variation of Team Game Tournament inspired by the UEFA 'Champions League' is used here to address learning outcomes for two different age groups, four modules, four engineering degrees and two countries during the 2013/14 and 2014/15 academic seasons. It is noticed that the more games between the teams, the more effective the team work and learning has become. Confidential questionnaires and end-of-semester exams confirm the success of the competition in enhancing student satisfaction and learning.

192 - Supporting Education and Learning with Game Design Elements

Siniša Krunić and Sergej Lugović

A phenomenon popularly known as gamification refers to the application of game design elements in non-game contexts with the goal of improving user engagement with the service. In recent years, it has garnered much attention and found its way into the education area where problems with maintaining student motivation still persist within some educational systems. In this paper, we're presenting the results of the analysis of three "gamified" educational platforms and elaborate in what way they implement elements of game design to motivate and engage users. We use previously developed methodologies, for the purpose of one of the author's master's thesis, which combines Werbach and Hunter's game element hierarchy with Deci and Ryan's self-determination theory to offer insight in interaction of system components with basic psychological needs. Our goal is to show how digital systems are using elements of game design to support basic needs and to provide reference for the design of future systems in educational contexts.

Parallel session ThA1

Professional skills

59 - Comparative Teamwork Skill Development in Different Engineering Topics

María Jesús González-Fernández and Eduardo Montero

Personal skills, like team behaviour, are definitely important outcomes of engineering courses. Team behaviour could change for the same person if the work frame changes or even if the team members change. This paper presents a case study of teamwork skill development within the scope of fundamentals of engineering topics in electronics engineering curricula. The aim of the paper is to compare team behaviour of individuals when facing teamwork within two different engineering courses. 54 students of the second year of a four-year degree in Electronics Engineering participated in an experience of teamwork skill development. The same set students took a course on Engineering Thermodynamics and also a course on Theory of Circuits. Both courses involved teamwork skill, though in different approaches and assessment. A rubric, intended to assess teamwork, was developed for the supervision of the teams and individuals with the requisite of being easy to understand by the students and short time consuming to fill it. Analysis of student's response is presented. Correlation between teamwork performance and learning results is also presented. Teacher's perception of the experience was obtained by means of personal interviews.

65 - Systematic Method for Teaching Engineering Working Life Skills

Petri Sainio, Seppo Virtanen, Johanna Isoaho and Jouni Isoaho

We present and demonstrate a systematic method for teaching working life skills to engineering students. An intended learning outcome (ILO) based approach is used for curriculum definition and development. The teaching of working life skills is implemented coherently using special courses and integrated learning in the technology courses. The specialized courses cover engineering basics, group work and product development during the first year of studies, and further courses on project and engineering skill topics targeted towards the implementation of a large-scale multidisciplinary development project in the 4 th – 5 th study year. Integrated learning is used because there is not enough space in our educational programs for multiple special courses solely for teaching working life skills. Moreover, there is no reason to fully separate working life skills from the technical context provided in technological courses. We split the engineering profession into smaller subcomponents which can be further defined as learning outcomes for working-life skills. These subcomponents are analyzed in the context of the very turbulent and globalized working environment of the engineering profession in the future. We conclude the paper by presenting our experiences gained in implementing the teaching of working life skills.

155 - Addressing the UK IT Skills Shortage: 'Tech Gold' Degrees

Kevin G. Doyle

This paper will outline how a sector skills council chaired, employer-led design and development team, informed by wider employer consultation, has been working with curriculum experts from partner universities (including UWE,Bristol) to define the learning outcomes of most value to the IT and Telecom's sector and to develop and deliver degree programmes that develop the knowledge and the skills required to enable students to secure careers in the IT world and to help to address the UK IT skills shortage. The background to and the rationale for the initiative is given by way of context, followed by an account of the development, implementation and operation (at UWE) of the first of the e-skills/Tech Gold degree programs; the BSC(Hons) Information Technology Management for Business (ITMB). Evidence for the successes achieved by the programme in relation to performance and employability is presented and used as justification for the development, implementation and operation of a new UK-wide programme in Software Engineering; the BSc(Hons) Software Development for Business (SDfB).

106 - Professional Skills Needed by Graduates Entering the Consulting Engineering Field

Barry A. Benedict and Lilia A. Abron

The senior author completed a non-traditional sabbatical spent with a highly successful, thirty-seven year old, medium-size environmental consulting firm. The authors reflect upon the skills needed by engineering graduates who enter that industry and the complementary roles of engineering education and the firms themselves in seeking to develop those skills. PEER Consultants, P.C., is headquartered in Washington, DC with offices in Baltimore, MD; Burlington, MA; Clearwater, FL; and Laurel, MD. PEER, with over 100 employees, primarily works with municipalities and has performed work in a number of environmental areas. In addition, a number of PEER engineers are "embedded" in client facilities rather than a specific PEER office, complicating efforts at communications. The following discussions integrate what happens (or does not happen) in engineering curricula and what PEER is doing to continuously maintain its competitive advantage.

140 - Student motivation in the development of professional skills

Pearse O'Gorman and Margaret Morgan

Within the packed undergraduate engineering curriculum the development of students' professional or 'soft' skills is often hampered by the demands of the numerically and technically demanding content. However, engineering employers are increasingly seeking graduates who have the right employability skills and so can make an immediate effective contribution in the workplace. The challenge for programme developers within Higher Education is to maintain the technical excellence within engineering degrees whilst simultaneously developing those soft skills and business awareness that industry has identified as being so important when recruiting graduate engineers. This is especially the case for Ulster University, which as a regional university, sees the majority of its graduates finding employment in small or medium-sized enterprises. Although educators generally have moved to meet both this expectation from employers and also to satisfy requirement of professional bodies for accreditation, many students still undervalue the opportunities they are offered to develop their professional skills. This paper presents the findings of a study conducted among undergraduate engineering students at Ulster University to elicit their attitude to the development of their professional skills. It compares the alignment of student attitudes with employer expectations. The impact of different approaches to the development of 'soft' skills is reported. Finally, approaches to curriculum design and strategies that may be adopted by course designers to help motivate the development of professional skills are described.

Parallel session ThB1

Curriculum Design

45 - The Research Proposition and Professional Development for First Year Graduate Student Preparation

David Ollis

More than 20 years ago, we hypothesized that a formal introduction to graduate research, via proposal writing and presentation, would lead to a faster research startup and integration into lab groups than the traditional informal approach of entering a lab, conversing with personnel, and "learning by doing" This paper demonstrates the validity of that hypothesis when it was tested by >300 PhD graduate student participants in such a writing and professional development course sequence. The writing components are a 10 page (fall) and 15 page (spring) formal proposals including hypothesis development, proposal outlining, draft and revised written proposals, followed by practice and formal oral presentations. The professional development components include research ethics, intellectual property and patents, advisor expectations, and lab citizenship and management. As research is the defining difference between undergraduate and graduate study, the offering of research initiation courses such as these ought to become more widely practiced.

161 - Candidates Ranking Models for Entering the Second and Third Degree of Academic Studies: Multi-criteria Approach

Milan Nikolić, Dragana Glušac, Maša Magzan, Dragica Ivin and Edit Terek

There has been an increasing interest of students in recent years for continuation of education at the second and third degree of academic studies. Since the accreditation of study programs significantly limited the number of students at Master and PhD studies the problem of ranking candidates has appeared. It is usually assumed that the main criteria for ranking should be the average mark from the previous study period, exam difference, if the candidates are coming from some other study programs, duration of the study program and scientific work of candidates. However, the problem arises from the lack of a model according to which these criteria would be calculated mathematically in order to be objective. This paper deals with two models: a model for ranking candidates for entering Master studies and a model for ranking candidates for entering PhD studies. The models are based on multi-criteria approach in which criteria and their weights are defined first and then the procedures of quantification and normalization of attributes follow. The presented models have been used successfully in the last three years at Technical faculty "Mihajlo Pupin" in Zrenjanin, the Republic of Serbia. These models can be more or less modified according to the needs and specific characteristics of concrete study programs but the main idea, mathematical, multi-criteria approach has to be kept. In this sense, a wider use of the suggested models is expected.

5 - Integrating principles of Universal Design into the Engineering Education Curriculum: Experiences from Norway

Frode Eika Sandnes and Hua-Li Jian

In recent decades the engineering education curriculum has changed from being purely technical oriented towards being more socially aware. Engineers need to be aware of the social impacts of their work and reflect upon the impact of their decisions. Most engineering studies have included elements of ethics for some time.

During the last decade, environmental issues including renewable technologies have gained an increasing emphasis. A new trend is that legislature in various countries requires the presence of universal design, where the environment be as accessible to a large segment of the population as possible, be it a physically-built environment or the virtual environment. These new expectations also require engineers to be aware of the problems and the impact of their work and to be trained to design with universal accessibility in mind. This paper briefly reviews (a) the phenomenon of universal design, (b) the recent trends in standards and legislature, and (c) how these changes are affecting the engineering profession. Provided also are experiences incorporating universal design in engineering education curriculum at several Norwegian higher education institutions.

138 - A new Introductory Course in the Engineering Education at the University of Tromsø

Arne Gjengedal and Tor Schive

In 2011 a new national curriculum for the education of engineers was established in Norway. The objective of the curriculum is to ascertain that engineering education is professionally oriented, integrated, research-based and has a high academic standard. Institutions are instructed to facilitate a holistic approach to the engineering profession, which integrates social science, technology, science and mathematics. A new introductory course for engineers was defined, and since 2012 every education institution in Norway has given freshmen engineering students the introductory course. The course should focus on the common aspects of engineering rather than discipline-oriented topics, motivate and create identity, and include social science. The guidelines accompanying the course are vague and it has been a challenge for academic staff to establish and run the introductory course. A survey has been carried out, and this paper presents the status of the introductory course three years after implementation. Examples from various engineering programmes in Norway will be presented. At UiT the course is called “Introduction to Professional Engineering Practice and Working Methods” (10 credit points). The course changed from 2012 to 2014, and new changes are considered for 2015. It is a “toolbox” for the students with elements useful in engineering: CAD, project work, report writing, laboratory work, data analysis, engineering economics, introduction to history of technology, technology in society and engineering ethics. The course gives an overview of the engineer profession with lectures from local industry. Different experiments include model wind turbine; measurement of dust in suspension; measurement of air quality; level, pressure and flow control in fluids; and measurement of temperature with different instruments.

24 - Make Engineering Curriculum Flexible: an Experimental Design in China

Yiming Rong, Haiyan Zhao and Dan Wu

As the rapid development of manufacturing industry and engineering science, engineering education faces new challenges for the need of quality engineering graduates. On one side, the engineering and science have merged together when nanotechnology goes more and more into products and industries. The manufacturing engineers need more frontier science thought and knowledge in even industrial applications. On the other side, the industrial competition for the variety of products and the new manufacturing technology development require entrepreneurial engineers capable to understand the problem and provide innovative solutions. At Tsinghua University, Beijing, China, an experimental reform of current curriculum of Mechanical Engineering is undertaken to enhance the flexibility of knowledge content and the way to inspire student learning, particularly for life-long learning and engineering practice with integrated knowledge. Principles and design consideration are introduced and discussed in the paper.

Parallel session ThC1

Mathematics in Engineering Education

17 - Engineering Students' Perception of Studies – a Comparison Based on the Students Educational Backgrounds

Janne Roslöf

Students enter higher engineering education with many different educational backgrounds. For example, the new engineering students of the Turku University of Applied Sciences (TUAS) consist of upper secondary school graduates with different selection of studies in Mathematics and Science, as well as students with various vocational qualifications many with modest additional mathematical studies after compulsory schooling. This heterogeneity presents one of the main teaching and learning challenges especially during the first part of the engineering studies. In this paper, a small-scale survey to the students of the Degree Program in Information Technology at TUAS is presented and discussed. The main research question was to find out how do students with different educational backgrounds describe their study paths, and to analyze if there are differences between these categories: Which courses the students have considered interesting, easy or difficult? The results indicate that there are certain statistically significant dependencies between the responses and the students' educational background.

19 - Mathematical vs. Engineering Understanding: Engineering Students' Perceptions (Work in Progress)

Ira Raveh, Elena Trotskovsky and Nissim Sabag

In this article, the results of an ongoing study, which looks into how BSc engineering students at an academic college of engineering, perceive engineering and mathematical understanding, will be conveyed.Eighteenstudents ofa course called "Technique, mathematical understanding and what is in between them" participated in the study. The course was taken as part of theirGeneral Studies program. The research tool is a questionnaire given during the first lesson of the course, which was analysed according to qualitative methodology. As to mathematical understanding, most of the references made by the students were in regards to the technical aspects of the subject at hand. In addition, the affective aspect of mathematical understanding stood out from the responses. Engineering understanding is usually perceived by the students as the comprehension of complex processes, which requires deep knowledge, a high level of cognitive abilities, and an application of the studied knowledge to various fields.

44 - Problem-Based Learning as a Strategy for Teaching Mathematics at Northwest La Salle University

Eusebio Jiménez-López, Gloria Isabel Morales-Bojórquez, Gabriel Luna-Sandoval, Lilia Beatriz Navarro-Fragoso, Martín Santacruz-Tirado, Ramsés Alonso Acuña-Espinosa, Rafael Durán Gibrán Amparán, Jesús Armando Cantú-Cárdenas

Learning of mathematics represents a challenge throughout university study program. Within a range of methodological approaches available for the learning, highlight the focus on competencies and active methodologies such as Project-Based Learning and Problem-Based Learning (PBL). In this paper the application of PBL is presented in a matter of vectorial calculus. Learning is organized around a problem learning trajectory

and transferred to a real situation in which students had to generate and select options for designing a simulator in MATHEMATICA software. To design it, they worked as a group and decided to use graphs, functions, differential and integral calculus, vectors and methods of polynomial interpolation. The results show that the technique of PBL was useful in the learning process, as it promotes creativity, critical thinking, managing complex situations, promote research and collaborative work.

76 - Using Educational Technology to Enhance Mathematics Learning

Einari Kurvinen, Rolf Lindén, Teemu Rajala, Mikko-Jussi Laakso and Tapio Salakoski

Mathematics is one of the most important skills for future engineers. Hence, special attention to mathematics education should be paid in all levels of education. However, due to scarce teacher resources and growing class sizes the possibility for personal tutoring is often hardly enough, especially for weaker students. We have developed an educational tool called ViLLE, with support for automatic assessment and immediate feedback for assignments. Despite being originally designed for programming exercises, the tool nowadays offers various exercises designed for mathematics education in all levels from elementary schools to universities. In this paper, we describe the automatically assessed exercise types designed for mathematics education. First, the design principles and the pedagogic background are illustrated. Next, the technical implementation is discussed as well as some challenges. Finally, we present some use cases on the various levels of education, with main focus on university level mathematics course. Results and feedback from student are reported and analyzed, following with our experiences and conclusions.

141 - Can Artificial Intelligence Help STEM Students Develop Intelligence?

Larissa Fradkin and James Uhomoibni

The word intelligence is widely used and has many meanings. In the educational context one talks of multiple intelligencies, including crystallized and fluid, the crystallized intelligence relying on the so-called declarative memory and the fluid intelligence, on procedural memory. The current approaches to STEM education are trying to shift from developing declarative memory to procedural and thus from developing their crystallized intelligence to development of fluid intelligence. We discuss these concepts in the context of mathematical education of engineers and give examples from our educational practice. We put a particular emphasis on the role of on-line resources and various interactive apps in developing students' intelligence. We discuss further why in our view, this task is important.

Parallel session ThA2

IT Global Influence

91 - Determining Agility Impact Index and Generating Employee Based Questions to Assess Organizational Agility

Gusts Linkevics and Uldis Sukovskis

Agile software development has become more popular during last decades. Learning to be agile is not an easy task and requires some effort. The problem is that organizations don't know at what level of agility they are and what they need to learn in order to be more agile. Purpose of this research is to determine AII (Agility Impact Index) of organization domains and create algorithm for generating employee based questions. Result of the research is a list of AII for the organizations domains and subdomains. Determined AII is used by created algorithm to generate more specific employee based questions to enable better learning of current situation in organization. Results will be used by method ODA (Organization Domain Agility), method of improving organizational agility.

181 - Indicators of Economic Development of Technologically Advanced Countries

Andrey V. Bystrov and Vyacheslav N. Yusim

Studies of the dynamics of most countries make it possible to assert that the development of the largest countries - technological leaders in modern conditions is characterized by a certain constant. It can be considered as "current macroconstant of development." The article demonstrates the fact of its existence and justifies statement that "current macroconstants of development" can and should be orienteers for strategic development for all countries pretending to equal economic and political relations with the technologically leading countries. The paper identifies conditions under which the group development macroconstant appears, evaluates particular values of macroconstants in different countries and shows advantages of long-term growth measure in the absolute values of the annual income per capita of the country change rate in comparison to other indicators. Conclusions in the work are based on the analysis of long-term data of total GDP, GDP per capita and their derivatives. Analysis has been done by using quite well known econometric methods - correlation, regression and cluster analysis. Practical importance of the results is characterized by opportunity of their use for long-term (15 years or more) forecasting and strategic planning of growth rates, both for companies and countries within industrial and economic policies.

109 - Searching for an Online Marketing Effectiveness: The Potential for a Small Business Sector

Philip Vranešić, Karmela Aleksić-Maslać and Maša Magzan

The paper describes the essence of online marketing for small businesses in terms of using the advantages of its tools and methods for better promotion and improvement of general business operations. A research involving small businesses in Croatia was done in order to define what tools and methods have the potential to increase companies' sales and advertising and whether they are used effectively. Despite a variety of elements in the online marketing that can help small businesses in Croatia in their promotion and sales growth, frequently an online marketing strategy is not appropriate which causes poor short-term or long-term results.

Such results discourage further use of online marketing tools and consequently underestimate its potential for small businesses. Changes brought by new technologies represent a big opportunity for marketing specialists to take a strategic role within the company. Such a role assumes recognizing the marketing potential of the new technologies, building stronger relationships with consumers and discovering new business opportunities through technology. The main challenge for marketing professionals, as well as scientists is the dynamic character of the Internet as a technology, market and a social phenomenon. The goal of this paper is to propose an optimal strategy for small businesses in Croatia that may guarantee the success of using online marketing tools today.

121 - E-Commerce Sales Promotion and Group Buying Concepts

Nela Maras, Olivera Jurković Majić, Ana Kuštrak Korper

Sales promotion is a key element of the promotion mix. It is consisted of many short-term ways to stimulate quicker or greater purchase of particular products or services by consumers or trade. Because of the market development, globalization, computerization and some negative aspects such as recession and lower purchase power, companies are turning to online forms of sales promotion. Group buying is one of the online forms. Over the past years, group buying has become a worldwide phenomenon and there are over fifty Internet sites which provide group buying services on the Croatian market. This paper discusses the benefits and the disadvantages of group buying concept both for sellers and for consumers. The sellers conducted the primary research on the satisfaction of group buying concept.

153 - Evolution of Technology in Risk Management

Goran Oblaković, Mato Njavro and Ivija Bernatović

This paper presents the field based evidence on changes in risk management practices in Swiss banks after the subprime crisis. Prior to the crisis risk management was dominated by technology, i.e. use of IT tools and complex models. In the most general terms the study concludes that the Swiss banks are slowly moving towards the culture of quantitative skepticism. The study concludes that installing and maintaining risk culture based on natural skepticism is the most crucial part, as well as the biggest remaining challenge and opportunity to improvement of risk management. Usage of IT and proprietary models lost their focal point and became just a starting point of the holistic based risk analysis. As this study argues for a more systematic view of risk it is also an extension of that stream, which additionally argues for a more holistic, independent and systematic risk management. It is a direct extension of the works of Mikes (2009) and Power (2009), as the study provides evidence that the culture of empirical skepticism is dominant in Swiss banks. Further, it extends on related concepts of two risk methods and four risk types by providing empirical evidence from Switzerland.

Parallel session ThB2

Project Based Learning

13 - Comparing Characteristics of final projects: BSc students vs. Practical Engineering students – the supervisors' point of view

Nissim Sabag and Elena Trotskovsky

Many researchers mention various kind of project learning. Inquiry-based learning, product-based learning, project-oriented learning and project-based learning are among the various terms associated with project learning. The two colleges in the common campus, the college of engineering and the college of practical engineering, carrying the similar name ORT Braude College (of engineering, or of practical engineering respectively), constituted a final project as an obligatory requirement for graduating. Although the degree of BSc is well recognized worldwide, the practical engineer degree needs to be explained as a degree on a higher level than a technician is but not as comprehensive academically as a BSc. The practical engineer degree requires two years of study after matriculation to complete. An interesting aspect to investigate is a comparison of the quality between the populations in terms of their final projects. Seven supervisors, who instruct both BSc and practical engineering students during project work, were interviewed and the project books of their students were analysed. The preliminary results show that BSc students are required to explain their design considerations, such as why they choose a specific method and discuss other options. They had to determine the product specifications prior to starting to design and to verify reaching the exact specifications. In contrast, the practical engineering students are required to explain the principle of operation of their project, and to demonstrate that the product functions appropriately. An additional important finding is that BSc students initiate the project topic more frequently than the practical engineering students do.

41 - The importance of criticality in (project management) competence research

Steven Nijhuis, Joseph Kessels and Ruben Vrijhoef

Six focus groups discussed various instances of criticality: in which processes is the presence of the project manager critical and what are the critical competences for a project manager. The results on processes show agreement on subject groups and processes. The results on critical competences show less agreement. There is a big difference in the distribution of critical competences compared to found important competences in recent publications. The competences in recent publications lack the specificity to create a comparison with the results of the focus groups on competence level. Although finding some examples, there is not enough material to prove or disprove the hypothesis that adding criticality to competence research is needed to reveal the essence of project management.

7 - Measuring Learning Gains in Project Management

Steven Nijhuis, Ruben Vrijhoef and Joseph Kessels

Teaching project management is becoming a standard part of curricula in higher education. Assessing the added value of the teaching efforts needs pre- and post assessments. Given the wide variety of skills and knowledge project management embraces a proper assessment of project management is difficult. A method of assessing added value has been designed and tested on the first part of a professional Master in Project and Process Management. The design is based on students assessment of learning gains (SALG) with several extra

criteria. The design was evaluated, updated and tested again. The third test with a tweaked design is being performed. The results do not convince that this SALG-based instrument can be used to measure added value.

85 - Real-world project management training for Small, Medium and Micro Enterprises (SMME) sustainability

Wilfred Fritz and Deon Kallis

South Africa is one of the countries with the largest disparity in wealth and standard of living in the world. This paper calls for an undertaking in line with the South African government's framework to empower entrepreneurs and community ownership and to overcome some of their shortcomings. This is also applicable to students who are upcoming Small, Medium and Micro Enterprises entrepreneurs in engineering. Two case studies in project design in the electrical engineering field are discussed to show the perception and psychological thinking of individuals about their performance. These students received formal project management training through a collaboration project between the Cape Peninsula University of Technology and the German based World of Eve and Training Development Consulting. The aim of these sessions was to empower entrepreneurs through formal project management training. This is later to be compared to the performance of electrical contractors and project managers in the real world, who did not receive any project management training.

110 - The Attributes of a Global Engineer Project: Purpose, Process, and Findings

Stephen Hundley

For the past several years, the American Society for Engineering Education's Corporate Member Council, reflecting the voice of industry, developed a series of attributes representing the desired competencies needed by engineers in order to effectively live and work in a global context. A global online survey was launched to validate the performance and proficiency levels of each attribute, and a series of global focus groups in every major region of the world have been held for the purpose of clarifying and refining the attributes. In 2015, the Attributes of a Global Engineer Project formally concludes its work, having benefitted from prolonged engagement with and input from globally-representative stakeholder groups of academicians and industry partners. This paper will describe the process to develop attributes of a global engineer; present a summary of key results; discuss how attribute outcomes can assessed in engineering education globally; and provide recommendations for a variety of stakeholders, with particular emphasis on lessons learned from the multi-year Project.

Poster/Demo Session

92 - A Blended Learning Signals and Systems Cours

Ana Pavani

Signals and Systems is a mandatory course in 5 curricula in the area of Science and Technology of PUC-Rio. This course has shown a very high failing rate – many students drop out or cannot pass the exams. Due to its importance, since its is a prerequisite to many other courses in 3 of the curricula, faculty started using more ICT – Information and Communication Technology tools to enhance the course and motivate students. In 2014, the course started being offered in the blended learning mode. Faculty have closely been examining the changes in the performance of students as well as submitting questionnaires to assess their opinions and contributions to enhancements (there have been many!). Starting next March, it will be offered by the third time in this mode.

The course is available from the Maxwell System (http://www.maxwell.vrac.puc-rio.br/) that combines a LMS – Learning Management System and an IR – Institutional Repository, among other functions. The online part of the course is made of various "pieces". They are:

- Roteiro (Course Guide) – is a large html file that is the "context" of the course. It contains the basic concepts and links to a set of vídeos, interactive objects, animations, different types of texts all on the Maxwell System and to activities. It also links to external Open Access contents.
- Class Notes – a set of three volumes with topics of the syllabus used to complement the text book.
- Text documents that contain exercises to be solved, a concise MATLAB® manual with many exercises to solve and a set of .m files with routines, assignements, etc.

There are communication tools as well – discussion forums, chats, mailing lists, agenda, bulletin board, etc. An last but not least, a set of administrative tools to inform students on tests dates, grades, assignements, etc.

The objective of this work is to demonstrate the online part of the course.

107 - Development and Evolution of A Capstone Project in Mechanical Engineering – A Twenty-Year Experience from Taiwan

Jhy-Cherng Tsai, Shean-Juinn Chiou and Jau-Liang Chen

As engineers are expected to be capable to define, to formulate and to solve an engineering problems, in particular industry-oriented problems as he/she graduates. While most university faculties focused on research-oriented training for engineering students, mainly because these faculties put most of their efforts in research, in the past decades. Many engineering graduates, especially in Asia, thus had difficult to adapt for industrial needs as they were lacking of training of the above-mentioned capabilities. This paper is intended to share experience on the development and evolution of the cirricurum on capstone project for junior and senior students major in mechanical engineering (ME) at the National Chung-Hsing University (NCHU). This cirricurum was designed in 1994 and started its first trial in 1995. To ensure students are able to learn the above-mentioned capabilities, the capstone project is designed that each team of students took a project designed by a faculty member with industrial experience. Each student is expected to explore the life cycle of a project, including the defining the scope, problem formulation, literature survey, exploring possible solutions,

SWOT analysis of each solution, determining the best choice under course constraints, feasibility demonstration with paper or plastic models, detail design and analysis, selecting and purchasing commercial compoments and subassemblies, part fabrication, assembly, testing and adjusting. In the first couple years, industrial experienced lectures, together with faculties, are invited to teach students knowledge and techniques for project development, as these faculties have limited industrial experience. Accessment of student performance is another issue as grading standard may different among faculty members. The grading system is gradually modified with 60% group grade and 40% grade from the advisor in the past few years. The 60% group grade was graded by faculty groups based on student final exam, mid-term and final presentations as well as the year-end final exhibition and competition. The other 40% grade by the davisor is based the weekly progress reports, performance, attitude and the term report of each student. Student parents and other students at lower grades are invited to participate the final exhibition and give comments. Three alumni, each from industry, academia and research institute respectively, are invited to serve as the judges for the competition, which gives three awards to the highest grades. This capstone project curricurim has been highly praised in the acrredation on engineering education conducted by the Institute of Engineering Education Taiwan (IEET).

15 - Engineering Design Education based on the CDIO Approach

Kazuya Takeamta, Akiyuki Minamide, Arihiro Kodaka and Hirofumi Yamada

CDIO is a framework for an engineering education curriculum to train the next generation of engineers. The framework is based on students learning the processes for real-world system and product design. Through this framework, students will experience the CDIO approach of Conceiving, Designing, Implementing, and Operating. The standards indicated by CDIO are not fulfilled by a single course, but instead by fulfilling the guidelines by coordinating multiple subjects in the curriculum as a whole. Kanazawa Institute of Technology has two engineering design courses called Design Project I (PD1) and Design Project II (PD2). PD1 is held in the first semester in first year, and PD2 is held in the second semester of the second year. By experiencing project design with PD1 and PD2, students can learn about the Conceive and Design aspects of the CDIO approach. We then expanded the program, and made it possible for students to learn every aspect of the CDIO approach in PD2. This paper describes and evaluates a test implementation of this course.

62 - Development of the Leadership Course through the Case Study Evaluation and an Analysis

Su-In An, So-Hyun Park, Hayoung Park and Myoung-Souk Yeo

To ensure that engineering students can be important leaders, the College of Engineering of Seoul National University has opened a leadership course called “Challenge of Engineering Students and Leadership” as part of the engineering curriculum. The objectives of this class are to motivate students to become passionate essential engineering leaders in the future and to introduce the career and engineering frontiers, which is expected to be important in the future. This class consists of two units. The first is entitled the “Leadership Unit,” during which students can learn how to be true leaders, and the second is the “Challenge Unit,” where students can be inspired to learn career paths engineering students may explore and current engineering frontiers unfolding. We were able to look back on our leadership training course, which we have run for two years. Through an in-depth analysis of lecture evaluations and interviews with students, we instituted an enhanced model to foster SNU students as global engineering leaders and sought ways to develop and cultivate true engineering leaders by implementing an improved course.

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