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New Trends and Challenges in Civil Engineering Education

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Keynote Lectures

Session 1: Teaching and Learning

Session 2: Civil Engineering Curricula: Old and New

Session 3: Bologna Implementation and Concerns

Session 4: PhD Studies

Session 5: Civil Engineering Curricula: Old and New

Session 6: Qualifications, Accreditation, Assessment…

Keynote Lectures

NEW TRENDS IN ENGINEERING EDUCATION: MEGA PROJECTS AND GLOBALIZATION

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There is a need for new engineering competences within green innovation. During the 1990s, lifelong learning and new competencies such as project management were identified as new requirements for higher education. During the same period, employability was on the agenda—the graduates and universities had to be more directed towards the labour market, and increased co-operation with industry was emphasised. Recently, a triple helix approach has formed the strategy for innovation based on close collaboration among government, businesses and higher education. This approach slowly saturates the development of higher education in general and engineering education in particular. The Europe 2020 strategy including the seven flagships witnesses an overall European strategy for closer collaboration among all of the stakeholders and especially for the development of sustainable innovation (Europe 2020). Also the Bologna Process in Europe stresses in particular that the important objective for engineering education is to improve graduates' competences in innovation and entrepreneurship. Furthermore, there is a clear aim for more student-centred learning, and the global trend towards formulating learning outcomes also points in this direction (Leuven Communiqué, 2009).

Innovation is not based on individual knowledge, but on collaborative knowledge and based on global knowledge sharing and networks. With the rapid change of technology, boundaries of professions have become progressively more difficult to identify. Problems are becoming increasingly illdefined and complex, involving a growth of various issues like culture, sustainability and society. In this circumstance, knowledge is progressively regarded to be complex, interdisciplinary, uncertain, and collaborative.

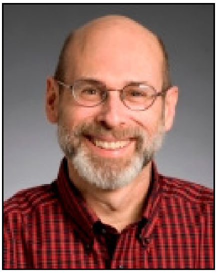
Also the approach to learning has changed. Learning is not only knowledge acquisition or participation in a social community; it is also about knowledge creation. To look at learning as a creation process provides a new way of thinking about the genesis of new knowledge as well as providing an approach for examining learning in terms of creating social structures and collaborative processes that support knowledge advancement and innovation.

Problem-Based and Project-Based Learning (PBL) is one of the innovative learning methods that higher education all over the world has implemented and PBL can be regarded as higher engineering education's response strategy to requirements from society. Especially in technology and science, research has shown that PBL has turned out to be an efficient method for students to achieve new types of process skills (such as collaboration, project management, innovation, creativity, and communication), and increase students' motivation for learning, entrepreneurship, and collaboration with society and regional development.
However, PBL is not just one model or practice. The first generation of PBL are the start of PBL universities in the late 1960s and early 1970s, research on the PBL-practice has shown that the PBL models have developed incredibly since the traditional Danish PBL-models and Maastricht and McMaster models in medicine. A second generation of mixed models have also been developed according to cultural diversity and subject areas.

From the requirements of globalisation, we are now approaching a third generation of PBL based on global collaboration among countries and changes in higher education in emerging economies. The third generation of PBL is therefore based on close cooperation between higher education and the region it is located in, the use of new ICT tools, international and intercultural collaboration, and the use of new business models.

This presentation will address the needs for new competences and the trends in engineering education going from a first generation of PBL towards interdisciplinary and global green innovation projects.

STATICS FOR ENGINEERS: FROM DIAGNOSIS OF STUDENTS DIFFICULTIES TO A STATICS CONCEPT INVENTORY AND AN OPEN COURSE



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An engineering education seeks to develop in students a broad range of skills. One skill is the ability to utilize scientific principles to design new systems and to make sense of existing ones. By the time students begin studying engineering at the university level, they have already had exposure to some scientific principles and some experience in applying them. Engineering education seeks to broaden that exposure to new principles and ideas, but also to deepen student understanding of ideas that already seem familiar. Given the wide range of learning resources (e.g. textbooks, web-sites) that are available to students, what effective role can the instructor play in the process of broadening and deepening student understanding?

Typically, instructors have minimal familiarity with how students conceive of the ideas and principles of the given subject and what students are thinking when trying to solve problems. This is perhaps the greatest obstacle to instructors that hope to intervene and help redirect students along more useful pathways. The author and colleagues have grappled with some of the challenges to offering students feedback and suggestions for improvement in Statics, the first engineering mechanics course that addresses equilibrium of solid bodies subjected to forces. In particular, we have wondered: what stumbling blocks and incorrect understandings prevent students from principled approaches to problems? Can we pose particular questions to effectively gain insight into our students' conceptions? Finally, how do we embed such questioning into on-going instruction so students can benefit directly and we can have something closer to continuous monitoring?

Our methodology for approaching these challenges started with field studies: the gathering and analysis of the work product of students engaged in solving Statics problems. The analysis consisted in placing errors made my students into distinct identifiable categories, and then recognizing concepts or clusters of concepts that are at issue in each type of error. Essentially we were identifying the most troublesome areas for students, with a particular focus on difficulties apart from mathematical analysis. But, instructors cannot on a routine basis identify the difficulties of their students by deconstructing their solutions to problems. Instead, with the picture of student difficulties coming into better focus, we sought to devise narrow questions, each focusing on whether a student possess one of the commonly observed misunderstandings. Interviews of students pondering such questions provided ideas for enticing incorrect answers, and those “distractors” suggested by interviews were combined with errors found from field studies. Collections of questions were gathered and administered as tests over a period of five years to thousands of students in many institutions, facilitated by a web-based implementation. The results were analyzed in ways that enabled the questions to be continually refined, resulting in a standardized test: the Statics Concept Inventory (also known as the Concept Assessment Tool for Statics).

Nearly concurrent with this effort, we sought out approaches that would make the accuracy of their understandings more visible to students themselves. This included prominently an adaptation of Mazur’s Peer Teaching Concept Tests to the statics classroom. Students would ponder questions and the possible answers, argue those answers with one another, and reflect on the ultimately revealed correct answer. This heightened our confidence that many important aspects of problem solving in statics could be re-framed to allow real time, meaningful engagement of students and instructors. Together with the identification of central concepts and common misunderstandings, this paved the way for a web-based Statics course. The course seeks to meet the apparently opposing goals of permitting asynchronous, as-convenient learning, while making students’ thinking visible to themselves and to instructors. The centralized data gathering on student activities has dramatically increased our potential for assessment and monitoring.

From these various efforts, we have found that performance on conceptual questions is indeed a useful barometer: it correlates positively at most institutions with other class-relevant measures such as final exams. At many institutions, students on average perform very poorly on conceptual questions that faculty might think are reasonably straightforward. There are particular concepts that appear to be particularly challenging to students. Focused instructional efforts can produce improvements in concept scores, which happily can still correlate with class exam performance. We also find that interactive activities can be developed, which productively engage students and assess them on a range of aspects of statics. In some respects though, we still fall short in the extent to which we can draw students into meaningful assessment loops. There are some very important and difficult concepts of Statics for which we have yet to develop effective ways of probing students, and it is remains challenging to assess students engaged in the types of problem solving that involve integrating different aspects or conducting more detailed analysis. While computer-based assessment methods can play a dramatic role in helping to monitor and promote learning, they have still not fully displaced one-to-one verbal interactions and thoughtful diagnosis of handwritten work.

THE WORK OF THE JOINT BOARD OF MODERATORS: REFLECTIONS ON THE UK ACCREDITATION PROCESS, EDUCATIONAL STANDARDS AND THE SKILLS NEEDED BY INDUSTRY

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FREng, BEng, PhD, DEng, DTech, FICE, FIStructE

This address provides a brief description of the work of the JBM (the “Joint Board of Moderators”) which provides independent accreditation of a wide range of civil engineering degrees in the UK (and a limited number of other countries). The JBM acts on behalf of four professional engineering institutions (ICE, IStructE, CIHT, IHE) to provide accreditation of the initial education component of professional qualification as a Chartered Engineer (or the lower grades of membership of Incorporated Engineer or Engineering Technician).

Typically each university is subject to a ‘visit’ on a five year cycle, and accreditation is then provided for a five year future intake. New courses, or courses subject to major changes, are dealt with on an ad-hoc basis. Prior to the ‘visit’ the University provides a very comprehensive submission on the course content and on the most recent output, as well as data on staff, facilities and a wide range of other background information.

The members of the JBM are all members of one or more of the four Sponsoring Institutions, and Board Composition is approximately 50% academics and 50% practicing engineers, from both consultants/designers and (to a limited extent) from contractors. On each ‘visit’ there will always be a similar split (typically 2 academics and 2 practising engineers).

As a deliberate policy the JBM allows a relatively wide variation in course content, with only three mandatory subject areas for Batchelor and Master level (BEng and MEng) degrees, as follows:

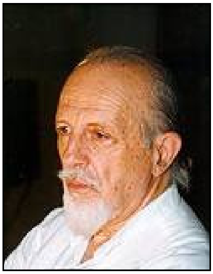
Structures
Geotechniques
Materials

Two further mandatory subjects can be selected from a short list of five, leaving the options open for courses with a 'theme', for example, in building structures; or in civil engineering with transportation; or civil and environmental engineering.

The Board looks for an holistic approach to two issues; namely design; and risk assessment/health and safety. It expects these attributes to be embedded into each course and looks for evidence that demonstrates this in the student output. As well as the continuing efforts made to respond to the 'requirements' of the professions and employers of graduate engineers, the current concerns of the Board for the short term and medium term are discussed as follows:

- Responding to a recent government proposal on future engineering education at university level generally
- Encouraging membership of a professional Institution amongst academic staff (controversially the JBM has issued guidelines requiring 50% of academic staff in accredited departments to hold a professional engineering qualification eg MICE or MIStructE).
- Encouraging an appropriate and coordinated approach to teaching sustainability, including technically quantitative assessments of energy and carbon usage
- Dealing with the rapidly changing economics of UK university education, which is currently undergoing the most radical change of the last 50 years or more

ENGINEERING EDUCATION POLICIES AND POLITICIANS…



Prof. T.P. TASSIOS
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1. Which are the optimum procedures for **political** decision-makings regarding Engineering Education?

2. The fundamental importance of detailed **“job”-descriptions** of Techical Staff, in Design, Construction and Research (as well as their Region-specificity).
   An attempt to redefine the job-descriptions of a Certified Technician, an “Industry” Engineer, an Engineer, and an Engineering Researcher.

3. Engineering Education befitting to a given “job”-description, leads to an appropriate “graduation”. For another “job”, another education programme is needed. (The misunderstandings produced by the term “post-graduate” course…).

4. The underestimation of the economical and social importance of Professional Education.

5. The apparent inadequacy of the BSc in Engineering in U.K. (where the Continental “Integrated and Uninterrupted” system is actually adopted, “MEng”).

6. The rather unfortunate attempt of Bologna-scheme to produce an “Industry” Engineer in 3 years:
   – Extreme difficulties in the 3-years curriculum itself.
   – The distortion of the programme imposed to the followers of the 5-years scheme.

- The unwillingness of the Industry to employ the “3-yearers”.
- The unwillingness of the students to step-out after the 3-years…
- An apparent conceptual mistake (hidden populistic trends; is a half-MD or a half-Lawyer possible?)

7. The apparent inadequacy of the 4-years BSc in Engineering in USA and the trend towards an “Integrated Uninterrupted” 5-years scheme in USA Universities.

8. The soundness of the “Integrated Uninterrupted” 5-years scheme of Engineering Education in Europe (which served already as a model in other Regions).
- Practical evidence
- Opinions of Bologna followers
- Fundamental Prerequisites

9. The need for rational-pragmatic job-descriptions to be served respectively (possibly accounting for Country-particularities)
a) by 3-years robust **non-university** studies (real “Industry” Engineers on narrow sub-fields),
b) by 4-years intensive University studies (if a national Market has a rich sector of medium-level Technology to serve),
c) by 5-years normal University studies aiming at medium and high Technology, on the one hand, and able to initiate possible doctoral studies, on the other;

overall cost-effectiveness being always considered.

10. The confusing (if not provocative) term “Master”:
- The confusion with the old-styled MSc: Engineering is a considerably broader intellectual process than Science
- Who are really the “Masters” in our world of today?
- Why a Region-specific term was used to express a successful European tradition of University Engineering Education?
- The Bologna Master simply befits the needs of a really Professional Engineer; nothing more nor less. It has nothing to do with… “post-graduate” courses (after a manifestly inadequate BSc).
- What is equivalent to what?

EUR-ACE®: THE EUROPEAN SYSTEM OF ACCREDITATION OF ENGINEERING EDUCATION AND ITS RELEVANCE FOR CIVIL ENGINEERING

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Globalization has stressed the international dimension of higher education, in particular in fields with per-se an international character, like engineering. Employability of engineering graduates are more than ever dependent on the internationally acceptability of the skills and abilities that they have acquired. It is fair to state that, while institutional accreditation may be significant to assure the quality of the teaching-learning process in each higher education Institution (HEI), only outcome-based programme accreditation can guarantee - to both the HEIs and the potential employers - that the graduates of a specific programme acquire the desired set of skills and abilities. And an internationally recognized qualification integrating a “national” programme accreditation, greatly facilitates employability and mobility of the graduates.

A good example for a mechanism for international recognition of qualifications is the European-based EUR-ACE Accreditation System, which provides a common framework for outcome-based accreditation of engineering programmes as suitable “entry routes to the engineering profession”, at the First- (Bachelor) and Second- (Master) Cycle levels, and provides a European quality label to programmes that meet the standards.

The EUR-ACE Accreditation System is essentially a bottom-up system, in which national (or possibly regional) Agencies accredit engineering educational programmes, and the European Network for Accreditation of Engineering Education (ENAEE) authorizes such Agencies to add a common quality label (the EUR-ACE® label) to their accreditation, after checking that their procedures and requirements satisfy the "EUR-ACE Framework Standards for Accreditation of Engineering Programmes" maintained by ENAEE itself (which implies satisfaction of the well-known "European Standards and Guidelines for Quality Assurance in Higher Education", in short ESG). In this way, the EUR-ACE Framework Standards do not substitute for national standards, while national differences and other specific requirements can be accommodated, and the experience of long-established national accreditation agencies (like the French CTI and the British Engineering Professional Institutions) is fully exploited.

The EUR-ACE Framework Standards are valid for all branches of engineering and all profiles of study, and distinguish only between First- and Second-Cycle programmes, as defined in the European Qualification Frameworks, but are applicable also to "integrated programmes", i.e. programmes that lead directly to a Second-Cycle (Master) engineering degree. This flexibility not only allows to accommodate national differences of educational and accreditation practice, but can also - as discussed in the last part of this lecture – allow to consider differentiations between different branches (or "disciplines").

The implementation of the EUR-ACE system started in 2007: at the time of writing, more than 900 EUR-ACE Labels have been awarded to First- and Second-cycle engineering programmes. Seven national Accrediting agencies, based in seven different countries throughout the European Higher Education Area (France, Germany, Ireland, Portugal and United Kingdom within the EU, Russian Federation and Turkey outside the EU) are at present authorized to deliver the EUR-ACE Label, while a similar number of other national accrediting agencies are already under review by the ENAEE "EUR-ACE Label Committee" for being authorized (and for a few the process is in a very advanced stage); other national Agencies are in the process of adapting their accreditation criteria and processes for compliance with the EUR-ACE Accreditation System, possibly with the help of "mentors" nominated by ENAEE. Some of these "new" Agencies (e.g. ARACIS of Romania and SKVC of Lithuania) are "general" QA/Accreditation Agencies that accredit engineering programmes among others; the establishment of subject-specific Engineering Accreditation Agencies is instead being pursued in some countries (e.g. Italy). The actual implementation varies from country to country; e.g. the French Agency (CTI) accredits only at the Master level, while the Turkish MÜDEK has required and obtained the authorization to award only First-Cycle EUR-ACE labels.

EUR-ACE has been quoted by the European Commission as an example of good practice in the “Report on progress in quality assurance in higher education” (September 2009) and mentioned also in the publication “The EU contribution to the European Higher Education Area”, issued in March 2010 in occasion of the “Bologna Anniversary Conference”.

As already stated, currently the EUR-ACE labels do not distinguish between engineering “branches”. Indeed, to this effect there are strong differences in accreditation practice among EHEA countries: e.g., in France the CTI “habilitates” a unique title of engineer (“ingénieur”), while the contrary happens in the UK, whose tradition is based on the “Institutions” of the different branches.

Consequently, there is an open discussion within ENAEE whether to stick only to the undifferentiated EUR-ACE labels based on the EUR-ACE Framework Standards, or to introduce differentiated labels that could exploit also the branch-level descriptors developed by relevant Technical Associations, like e.g. EUCEET in the Civil Engineering field and the European Federation of Chemical Engineering.

This lecture intends to contribute to this discussion with an up-to-date review of the situation, and some personal remarks and proposals by the lecturer.

Session 1

Teaching and Learning

INFORMATION TECHNOLOGIES IN STRUCTURAL ENGINEERING: A PAPERLESS COURSE

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This paper presents the structure of an undergraduate course entitled "Programming Techniques and use of specialised software for Structural Engineering" which is offered to the 5th year students of the Civil Engineering Department of Aristotle University Thessaloniki in Greece. The aim of this course is to demonstrate the use of new Information Technologies in the field of Structural Engineering and to teach modern programming and finite element simulation techniques that the students can in turn apply in both research and everyday design.

Apart from demonstrating the programming and simulation techniques and tools currently available, the course focuses on the physical interpretation of structural engineering problems as they are discussed in class, in a way that the students become familiar with the concept of computational tools without losing perspective from the engineering problem studied. For this purpose, a wide variety of structural engineering problems are studied in class, involving problem solving related to structural statics and dynamics, earthquake engineering, design of reinforced concrete and steel structures as well as data and information management.

The main novelty of the course is that it is taught and examined solely in the computer laboratory ensuring that each student can accomplish the prescribed hands-on exercises on a dedicated computer, strictly on a 1:1 student over hardware ratio. Significant effort has been put so that modern educational techniques and tools are utilised in order to offer the course in an essentially paperless mode. This involves electronic educational material, student information in real time and exams given electronically through an ad-hoc developed, personalised, electronic system. The feedback received from the students, also in the form of an automatically processed web-based questionnaire, reveals that the educational digital media used and the structure of the course itself, meet the main course objective to familiarize the

students with modern technologies without losing focus to the physical engineering problem studied.

KEYWORDS

Computer applications, Engineering education, E-learning, Programming techniques, Finite elements, Structural engineering, Information technologies.

A TRAINING DEMONSTRATION PROJECT FOR CURRENT AND FUTURE WORKFORCE IN A COUPLED NATURAL HUMAN AGRICULTURAL ECOSYSTEM

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The primary objective of this paper is to train current and future “workforce” to develop effective cyberinfrastructure (CI) components to support observatories gathering data in agricultural ecosystems and policy pertinent to engineering curriculum. This project aims to transform/enhance an existing University of Iowa (UI) watershed educational project from being a local-scale project to a more generalizable CI-based project that can serve as a pathfinder to effective larger-scale activities on future observatories.

To achieve a generalizable CI model, an emphasis would be placed on developing an open, web-based CI framework and prototype for data collection and servicing of the data from hydrological/environmental sensor networks including market analysis. The web-based model facilitates easier access of the data, and deployment of the sensor data service. More specifically, the project intends to develop a web-based cyber-infrastructure model for sensor data collection, retrieval, and analysis based on the prototype of HIDE – Hydrological Integrated Data Environment.

The study has taken place in Clear Creek watershed. Clear Creek watershed has been experiencing severe surface erosion (the highest in Iowa) due to gully erosion and current land-use practices. The watershed, due to its close proximity to the UI campus, is ideally suited for performing CI demonstration projects, such as CI sensor deployment, data storage, data retrieval, modeling and visualization. The existence of conventional (e.g. computer networks) and emerging (e.g. network of sensors) CI components in Clear Creek and on the UI campus allows versatile use of these components for training purposes.

The hallmark of this educational program is an interdisciplinary effort that emphasizes agency training & public outreach and university/college training. The active participants are: The University of Iowa (UI) and IIHR-Hydroscience

& Engineering, and the USDA-NRCS, and the Clear Creek Watershed Enhancement Project Group (CCWEPG).

The impact of this study is significant in reshaping the educational curriculum of engineering and science disciplines and in providing training and outreach material for other user categories. Specifically, the demonstration project will:

1. Develop an integrated curriculum that promotes across the discipline courses for future engineers and scientists. This will be of the first kind in this country.
2. Train workforce to design and maintain CI tools to address future societal needs related to environments and extensive urbanization and other land uses.
3. Train engineers and researchers to exploit CI tools to understand major regional-scale problems that have impacts on the national contaminated scale such as hypoxia problems.
4. Encourage agencies and universities to change the traditional approaches for studying earth surface processes and adopt the CI framework.
5. Develop a conceptual CI framework that can help agencies and universities to deal with huge amount of continuous data to better manage, store, analyze and present their received information.

KEYWORDS

Water, Biogeochemistry, Environment, Scaling

CURRICULUM DEVELOPMENT USING GRAPHS OF LEARNING OUTCOMES

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Students may not always have a clear picture of how courses in university studies are connected to each other and how they contribute to professional competences. For example, basic courses in the beginning of studies may be unmotivating because they seem abstract and unconnected to practice. The whole degree program may seem like a list of mandatory courses without much justification on why each topic must be studied.

To give students a more meaningful picture of how the courses in a university curriculum contribute to future courses and to higher-level goals, we propose a curriculum model that defines the connections between learning outcomes of different courses in detail. In our model, the learning outcomes of each course are identified, and prerequisite dependencies are specified between course outcomes instead of between whole courses. The instructor of each course specifies which topics from earlier courses must be known before the new topics can be learned. This way, the outcomes form a graph, or a network, which emphasizes the hierarchical nature of knowledge.

The outcome graph-based curriculum model offers advantages for both students and staff. Learning paths can be visualized to show students how each course contributes to the professional competences. We hypothesize that studying motivation is increased when learning outcomes are tied to higher-level goals. Students can also be given more freedom to construct a personal competence profile according to their own interests. The list of courses required to build the desired competences can be automatically calculated from the outcome graph. The dependency graph can also help staff to identify problems in the curriculum. It will reveal if a skill in a target competence cannot be developed from the available outcomes of existing courses or if a learning outcome of some course does not contribute to any professional competence or advanced course. Unnecessary overlaps or insufficient coverage of important topics can also be identified.

We are developing the outcome graph-based curriculum model in order to develop the Structural Engineering and Building Technology curriculum at the department of Civil and Structural Engineering at Aalto University. However, the proposed concept is generic and can be applied to any field where knowledge is hierarchical and courses have prerequisite connections. Our model is not in use by students yet. In this paper, we are reporting work in progress and discussing possible advantages and disadvantages of the concept.

KEYWORDS

Curriculum development, Learning outcome graph, Core curriculum analysis

STUDENT PERSPECTIVES ON COMMUNICATION: A CASE STUDY ON DIFFERENT METHODS OF COMMUNICATION USED BY ENGINEERING STUDENTS

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The purpose of this paper is to provide insight into the different communication methods used by engineering students in order to improve engineering teaching and learning. As part of a second year Project Management module, engineering students participated in collaborative group work. This involved 320 engineering students, organised into 54 groups, competing in a simulated business environment. As part of their final group reports, students were asked to describe and assess the methods of communication used within their group and with members of staff. The student responses identify how online forms of communication were used alongside more traditional forms. The responses also highlighted the perceived advantages and disadvantages of different communication methods and offered valuable insights into student practice within a collaborative learning environment. This paper investigates how these findings can be used to improve teaching techniques within engineering and particularly in supporting large numbers of students in collaborative group projects.

There are two sections of analysis within this paper. The first investigates communication between students engaged in collaborative work; the second considers communication between student groups and teaching staff. Each section will present the methods used and the perceived advantages and disadvantages of each.

The case study results indicate that students utilise multiple means of communication and develop the skill of being able to assess the advantages and disadvantages of specific methods. They can adapt their communication to suit the different methods and will make use of one method to supplement the perceived deficiencies of another. The paper also describes how student perception of communication can be used to inform learning techniques and practices.

KEYWORDS

Engineering education, Collaborative learning, Student communication, Multi-modal communication

DEFINING A WORKPLACE EXPERIENCE FRAMEWORK: ANALYZING THE SOCIAL HEARTBEAT OF AALTO UNIVERSITY DESIGN FACTORY

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Organizations in both the public and private sectors are widely embracing new ways of working. A student-centred approach to learning is becoming more common and concepts such as “new learning”, “new learning environment” and “constructive learning environment” have emerged. Learning environments need to evolve with the change in students’ learning styles, aspirations and expectations. Today’s learning environments should facilitate meaningful, authentic activities that help the learner to construct understanding and develop skills relevant to problem solving. The use of university spaces is transforming. Formal learning, which has traditionally taken place in conventional classrooms, is becoming virtual thanks to internet-aided learning technologies, whereas the need for physical spaces intended for informal learning is increasing.

The aim of this research was to understand the purpose and importance of informal social face-to-face learning spaces for their users. The model of “6 dimensions of user experience” was applied as a data-gathering framework in this study. The research was conducted in Aalto University Design Factory and is related to the user experience of its common cafeteria, “Kafis”. Data were gathered by means of focused interviews among 16 users of Kafis, representing students, researchers, start-up entrepreneurs and staff members. The data were analysed by microanalysis by identifying repeating concepts from the data.

According to the results, it seems that the key function of Kafis is to offer a platform for socialization and sharing knowledge between its members. Furthermore, the metaphor “the social heart of the building” describes the importance of having this kind of place in the university environment. The social heart refers to a shared place that is welcoming to its users and has an open and cosy atmosphere. The research indicates that people create meaning for a place. Therefore, bringing people together is essential. However, to get the best outcome from these kinds of places, it is necessary to broaden the perception of work. In addition to individual work related activities, such as shortening the task list in front of one's desk, work could also be understood as something that essentially includes collaboration between people, such as interaction and knowledge sharing.

The research provided evidence of the suitability of the model of "6 dimensions of user experience" as a starting point for a workplace experience research study. Future investigations relating to workplace experience research will focus on identifying workplace experience profiles of co-working spaces for learning, including informal social face-to-face learning spaces studied in this research. The next step would be to conduct a virtual survey research study. For future research purposes, the workplace experience framework was generated in the research.

KEYWORDS

Informal social face-to-face learning space, Co-working space, User experience, Co-working, University facilities, Higher education

Session 2

Civil Engineering Curricula: Old and New

A CULTURAL DIVIDE? DIFFERENT MODES OF TEACHING CONSTRUCTION MANAGEMENT

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The area addressed in this paper deals with the Teaching Modes most suitable to educate and train Students and Practitioners in Construction Management. It posits that Construction Management might be taught more often and more engagingly through a Project-Based Learning approach. As demonstrated at Imperial College London, Active-Learning Based Programmes and Modules can integrate Construction Management learning in modules that are studio-based (Creative Design), classroom-based (Energy and Infrastructure: Project Management) and field-trip based (Constructionarium). Another well-known and widely-used active-learning project is the Peri Construction Exercise.

This paper looks at both the Peri Construction Exercise and the Constructionarium, both of which ask students to cope with real engineering questions and both of which are used in multiple universities across a range of engineering and building degrees, for students of various levels. The two different educational programmes feature, and are affected by, quite different attitudes concerning the project scope, procedures, locations, resources, assessment and accessibility. However, both Educational Modules allow Students to be aware of the real pitfalls of construction, the behaviours required of engineers, the application of theoretical knowledge and practical know-how, and the management of purposeful engineering activity to requirements of time, cost, quality and safety.

The main findings that the authors present involve the difficulties and desirability of potential International Educational Joint Modules which might enhance a pan-European Approach to Active Learning in Construction Management. The advantages that can be gained can serve the interests of academic standards through enhanced knowledge-sharing whilst achieving a sensible response to difficulties in the economy through better utilisation and sharing of resources. The industry-centric focus of active-learning means that it can help with a better uptake of Building Information Management (BIM) approaches and a better understanding of what BIM means in different countries and different sub-disciplines of engineering and construction. All active learning using team-based projects leads to students having to communicate, and International Educational Joint Modules that have a focus on management and practice are expected to lead students (and staff) to a better understanding of management cultures in different countries, and improved preparedness of engineers for more open markets in construction.

KEYWORDS

Project-based learning, Construction management, Building information modelling and management, Active learning

THE ROLE OF EERI SEISMIC DESIGN COMPETITION IN IMPARTING TECHNICAL COMPETENCE AND PROFESSIONAL EXPOSURE IN THE UNDERGRADUATE CIVIL ENGINEERING CURRICULUM

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In today's world it is extremely essential that undergraduate civil engineering students have the ability to analyze and solve engineering problems by applying basic principles. In order to do so, it is very important to integrate various fundamental fields to understand the impact of civil engineering solutions in a global and societal context consistent with the principles of fundamental mechanics. At the same time, professional exposure is needed to steer them in the right direction with regards to choosing a suitable career.

A short description of existing international framework standards for the accreditation of engineering programs is provided with reference to: EUR-ACE, (European Accredited Engineering Programmes), Civil Engineering Body of Knowledge for the 21st Century (American Society of Civil Engineers), EUCEET (European University Civil Engineering Education and Training). It is acknowledged that these institutions and frameworks recognize common outcomes for accredited engineering degree programs. Specifically, EUR-ACE specifies six types of outcomes: knowledge and understanding, engineering analysis, engineering design, investigations, engineering practice, and transferable skills.

The Seismic Design Competition (SDC) is organized by the Earthquake Engineering Research Institute (EERI) Student Leadership Council (SLC) in the United States, in conjunction with the EERI Annual Meeting. The 2011 EERI Annual Meeting, with the theme "Earthquakes without Borders," hosted the 8th SDC in La Jolla, San Diego, California between February 9 and 11. The objectives of the SDC are: (a) to promote the study of earthquake engineering amongst undergraduate students, by providing them an opportunity to work on a hands-on project by designing and constructing a cost-effective frame

structure to resist earthquake excitations, and (b) to build the awareness of the versatile activities at EERI among the civil engineering students and faculty as well as the general public (national and international).

KEYWORDS

Earthquake engineering, Undergraduate curriculum, Technical competence, Professional exposure

EDUCATING CIVIL ENGINEERS ON HAZARD MITIGATION AND SUSTAINABILITY

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Sustainability and hazard mitigation are two of the rather new notions that attract increasing interest in civil engineering curricula. Sustainable development has been defined as “Development that meets the needs of the present generation without damaging the capacity of future generations to meet their own needs”. Therefore, sustainability is an important aspect of civil engineering projects. Hazard mitigation can be defined as any cost-effective action taken to eliminate or reduce the long-term risk to life and property from natural and technological hazards. So, it is relevant to design, construction and operation of small and large scale human projects that could be threatened by natural forces or by human errors and malicious activities.

In this paper it is argued that, together with the introduction of specific courses (usually elective) on sustainability and hazard mitigation, more attention should be paid to some underlying notions or principles, such as risk analysis, passive safety, carrying capacity, resilience, efficient use of locally available materials, respect of local environment, use of the simplest efficient technology for each task, consideration of non-structural measures for safety maximization. First the aforementioned notions are briefly outlined and then their integration in civil engineering curricula is discussed. The Department of Civil Engineering of Aristotle University of Thessaloniki has been used as an example, typical for Greek Universities. The official bulletin of the Department has served as basis, but informal author’s knowledge has also been taken into account. It has been concluded that sustainability and hazard mitigation are discussed in many courses, mainly elective. Nevertheless, they could be introduced in more compulsory courses, while an elective course, dedicated to them, would be very useful. More discussion of the underlying notions and principles would be useful, too. These results could be considered as indicative of Greek Civil Engineering Departments.

KEYWORDS

Sustainability, Hazard mitigation, Risk analysis, Passive safety, Resilience, Carrying capacity, Civil engineering curricula

SASICE: SAFETY AND SUSTAINABILITY IN CIVIL ENGINEERING

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The performance of the built environment and the construction sector are of major importance in Europe’s long term goals of sustainable development in a changing climate. At the same time, the quality of life of all European citizens needs to be improved and the safety of the built environment with respect to man-made and natural hazards, such as flooding and earthquakes, needs to be ensured. Education has a central role to play in the transformation of a construction sector required to meet increasing demands with regard to safety and sustainability.

In this paper, work in progress of the SASICE (Safety And Sustainability In Civil Engineering) project is presented. The aim of this project is to promote the integration of safety and sustainability in civil engineering education. The project is organised in the context of the Lifelong Learning Programme, funded by the European Community. The coordinator organisation is the University of Bologna. Nine partner universities from different countries are involved in this transnational project. The universities participating to the project constitute a network of high level competences in the civil engineering area, with several opportunities to improve lifelong learning adopting different media: joint curricula, teaching modules and professor and student exchanges. As a response to the challenge regarding new educational methods in sustainable engineering, teaching modules are developed in 4 thematic areas: (1) Safety

in construction, (2) Risk induced by Natural Hazards Assessment, (3) Sustainability in construction, and (4) Sustainability at the territorial level. The development of the teaching modules is based on an extensive analysis of the need for highly qualified education on Safety and Sustainability involving all relevant stakeholders (European and national authorities, companies, research institutes, professional organizations, and universities).

The main target is enabling students to introduce these advanced topics in their study plans and curricula and reach, at the end of their studies, a specific skill and expertise in safety and sustainability in Civil Engineering. With our natural resources fading away and our infrastructure in dire need of repair, new trends and challenges in civil engineering education in the concept of "Sustainable Development" are needed to be addressed.

KEYWORDS

Civil engineering, Engineering education, Safety, Sustainability, Natural hazards, Risk

ON THE ECONOMIC APPROACH TO NATURAL HAZARDS MANAGEMENT: WHAT ECONOMICS CAN ADD TO COMMON TECHNICAL KNOWLEDGE ON HAZARD-RISK BINOMIAL IN ENGINEERING DESCIPLINES

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Technical knowledge has been subject to a continuous adaptation process along the last 20 years, and a lot of new issues and problems have been attracted and included in Civil Engineering paradigm in this period. Environmental issues that were marginal subjects in the sixties are nowadays part of the core knowledge developed under the umbrella of the "Common Technical knowledge" of Civil engineers. One of the most characteristic issues that have followed this path is the subject of natural hazard -risk management. While societies have reached an increasing level of awareness about the challenge we face in this area, a broad set of approaches have been involved in knowledge development. These areas go from geographic sciences (focusing on physical sources of vulnerability and measures of natural events), social sciences (focusing on economic and social sources for vulnerability and resilience), and biological sciences focusing in environmental consequences both from natural events and for human induced changes. The fragmented origins of knowledge have produced an academic literature that shows a clear lack of consensus among basic concepts, measures and indicators.

Economic disciplines have been traditionally involved in engineering analysis, through the conventional CBA approach that traditionally played an auxiliary role for engineers when huge amounts of resources were mobilized in the construction of big infrastructures. Hence this paradigm was supposed to serve as overall framework for natural hazards related technical decisions. Nevertheless two specific issues have emerged in the process, which require some reflection: The unexpected high level of risk we face, and the need to adopt sustainable strategies. These issues need to be considered to develop a general framework, as far as they should serve as a robust basis for knowledge development and assignment criteria. Hence decisions in the field of risk adaptation or mitigation will be better implemented.

There is a continuously increasing perception of hazard exposures in our society that has attracted the attention towards this subject, and unveiled the unexpected relevance of involved decisions in these areas. On the other hand, sustainability issues have emerged in parallel with economic analysis, asking for new decisions criteria in order to approximate technical issues to intergenerational equity restrictions.

The aim of this paper is to investigate the existence of a common basic knowledge that helps to efficiently decide on resource assignment, by indexing the different approaches on the literature that may serve as a common knowledge for engineering learning. The paper is organized as follows. First, we review the different risk assessment frameworks in the existing literature. Then, we compare the different conceptual approaches and clarify the assumptions yielding behind each ones. Third, we review the contribution from economic approaches to the issue. And fourth, we derive some theoretical conclusions on the role played by the different multidisciplinary contributions.

KEYWORDS

Evolutionary, Institutional, Resilience, Vulnerability

Session 3

Bologna Implementation and Concerns

CIVIL ENGINEERING EDUCATION AND THE BOLOGNA DECLARATION: A GREEK RETROSPECTIVE

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Although the Bologna Declaration appears to be adopted almost throughout Europe and its environs, Greece strongly objects to its implementation. Some reasons (which may equally apply to the rest of Europe) are as follows: Education was founded in ancient times and represents a global way of thinking encompassing virtue, morals, ethics, etc. It is believed that multidisciplinary civil engineers with a broad education in many matters are required and engineers with strong personalities are needed that are able to take responsibility. Specifically, Greece is the most earthquake prone country of Europe and every civil engineer must have a strong structural engineering background in seismic design. While other European countries may consider earthquake engineering as a subject for specialisation, this complex topic is the core subject encompassing a whole section of studies. Much of the infrastructure in Greece is still to be built. Every structure, no matter how small, by law requires earthquake effects to be taken into consideration. The Greek individualistic nature demands that every building is different and manifests itself in the existence of very few large civil engineering companies. Rather, the norm is a single person or two or three persons working together in a small office. Greece has a particularly unskilled workforce in the construction industry. These reasons promote the need for all civil engineers to be highly educated and to be capable of dealing with all the various demands of civil engineering.

Amongst other things, the Bologna Declaration involves the implementation of a two-tier process in civil engineering. Before the Bologna Declaration, an integrated system existed throughout most of mainland Europe. For financial reasons, competition for university places in Greece is extremely high and only the best of the very best are accepted. The two-tier system essentially creates a second-class civil engineer with a three-year qualification. This may not be suitable for the best of the very best students. Any university education must be geared towards the projected demands of the workplace. A

European wide standardized education is an attractive idea with many advantages but any individual country must firstly look after the needs of its own population. When considering the special needs of Greece, it is believed that a two-tier system is not capable of educating civil engineers to the appropriate levels of knowledge and expertise required.

This paper details the reasons for Greece's strong objection to the Bologna Declaration before going on to investigate if other European countries experience of the experiment has been successful or not. At first glance, it is found that the principles of the Bologna Declaration have been implemented in nearly all education systems throughout Europe. However, further investigation reveals that there is considerable concern over the application of the Bologna Declaration to civil engineering education. That is, relevant civil engineering education societies and associations as well as academics and students in many European countries are calling for a return to the integrated continental system for civil engineering education, if this has not already been instigated.

KEYWORDS

Bologna declaration, Civil engineering education, Continental system, Two-tier system

CIVIL ENGINEERING EDUCATION, 12 YEARS AFTER BOLOGNA – A CASE STUDY: ROMANIA

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The paper updates the one written in 2004 by the author and published in the 4th EUCEET Volume dedicated to national reports on civil engineering education in Europe.

In the academic year 2011 - 2012 there are 112 universities in Romania, of which 56 public universities, 35 private accredited universities and 21 private authorized universities. From the 56 public universities, 12 are offering programmes in civil engineering and related fields. As related fields are considered: Installation engineering, Engineering Geodesy, Environmental Engineering, Mechanical Engineering, Engineering and Management.

Each year, the Ministry of Education submits for approval by the government a "*Nomenclator*" of fields and specializations. For the academic year 2011-2012, the "*Nomenclator*" lists 27 engineering fields. For the 27 fields, there are a total of 148 specializations, from which 13 belong to civil engineering field and 8 to related fields.

Before the implementation of the Bologna Process, the system of engineering education in Romania was a pure "**continental**" or "**binary**" system, with two types of programmes: a short (three-year) programme leading to the degree of "*inginer colegiu*"; and a long (five-year) programme leading to the degree of "*inginer diplomat*". The single-tier programmes of long duration (five-year) were predominant.

The implementation of the Bologna Process in Romania was set in motion by the "*Law on the organisation of university studies*" (Law 288/2004) and produced the following major changes in engineering education: the short 3-year programmes were dismantled and the long 5-year programmes were replaced by a two-tier type of education, with a first cycle of 4 years (240 ECTS) and a second cycle of 1,5 – 2 years (90 – 120 ECTS). Graduates of the first cycle degree programmes ("*licența*") receive a diploma of engineer, while the graduates of the second cycle degree programmes receive a diploma of Master.

The paper presents the structure of the study plan for a new 4-year programme, in which ¾ of the contact hours relate to core material and ¼ to specialisations.

A section of the paper is devoted to the Master programmes which were first offered in 2009 – 2010.

The last part of the paper is devoted to the implementation in Romania of the European system of accreditation in engineering EUR-ACE.

KEYWORDS

Bologna process, Civil engineering education, European higher education area, Integrated programmes, Two-tier system, Accreditation

CIVIL ENGINEERING STUDIES AT THE SILESIAN UNIVERSITY OF TECHNOLOGY ACCORDING TO THE BOLOGNA DECLARATION

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In 1945, after World War II, the Polish government established new technical universities. The Silesian University of Technology was one of the first among those and it consisted of four faculties: Mechanical Engineering, Electrical Engineering, Metallurgical Engineering and Civil Engineering. The name of the Civil Engineering Faculty has been changed a few times; since 1977 it has been called “Faculty of Civil Engineering”. The academic staff of the new university was recruited from Lvov University of Technology (Politechnika Lwowska), which was moved from a former eastern part of Poland to the western part, in Wroclaw and Gliwice. The present structure of the university consists of 13 faculties with more than 30 000 students. The Faculty of Civil Engineering consists of eight departments and one laboratory and employs about 190 academic staff (including 9 full professors) and currently teaches 2500 students.

The methods of education have been continually improved during the history of Faculty. According to the Bologna Declaration, and in order to provide the unified educational level to the students in Civil Engineering Faculty, the Ministry of Science and Higher Education introduced the so-called educational standards. It is noted that the educational standards are created for all the faculties of studies, independently from the faculties themselves. The new type of studies according to the Bologna Declaration has been introduced to the educational system of the Faculty of Civil Engineering since the 1999/2000 academic year. As a result, the studies currently consist of three-tiers (three levels):

- tier I – lasts 8 semesters, includes 2880 hours of teaching (full-time studies), concludes with a Final project and leads to a BSc degree (Engineer degree in Poland);
- tier II – lasts 3 semesters, includes 1080 hours of teaching, concludes with an MSc thesis and leads to an MSc degree;

- tier III – lasts 8 semesters, concludes with a PhD thesis and a defence of the doctoral thesis and leads to the degree of PhD in Science (PhD Engineer in Poland).

The Faculty of Civil Engineering at the Silesian University of Technology takes pride in the many years of tradition of higher education and the high quality of the graduates entering the job market. In order to meet the demand of the constantly changing job market, the curricula of studies have been prepared in such a way that they give students the possibility to study in European universities within the Erasmus program, taking part in the international student exchange system. Enabling the students to study partially in universities abroad significantly broadens their possibilities of entering the open European job market. The curricula of studies are adjusted to the standards prepared by the Ministry and the positive opinion of the State Accreditation Committee guarantees the high level of education for future graduates. Thanks to the constant development of the staff of science experts and their devotion to the didactic process, education should remain on a high level. Close connections with the industry enable to create such plans of studies, so that the knowledge and the abilities of the graduates meet the needs of the industry of today.

KEYWORDS

Two-tier studies, Civil Engineering education, Requirements of civil engineering degrees in Poland, Erasmus program

CIVIL ENGINEERING EDUCATIONAL STANDARDS IN RUSSIA

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Higher education in Russia faces today problems connected not only with current requirements of national economy and the need for qualified professionals, but also with the integration into the European and international educational systems. In 2003 Russia joined the Bologna process, which aims at the creation of a uniform European educational space. Many Russians had the opinion that the process is going to reform higher education system in Russia according to European standards and to implement training under "the European" programs. Russia's joining the Bologna Declaration offers the possibility for Russian Universities to participate in European educational projects, and opportunities for students and academic staff to participate in academic and scientific mobility activities. It should be mentioned that two-level education exists in Russia since 1992, but it was mostly implemented in the fields of economics, management and the humanities. Engineering programs traditionally followed five year curricula.

Higher education in Civil Engineering in Russia is offered by 14 Civil Engineering Universities and more than 140 Civil Engineering Faculties in Technical Universities. All these institutions belong to the Association of Civil Engineering Higher Schools (ACEHS). The main goal of the academic community of Civil Engineering was to create adequate bachelor and master educational standards and programs acceptable both by universities and employers from industry. At the moment there are 15 specialties in civil engineering education in Russia. They are covering main professional areas – construction, technology of construction materials, engineering systems (water supply and waste water treatment, heat- gas supply and ventilation) etc.

The new Standards in education stipulate a single unified Bachelor's Standard for civil engineering. The former civil engineering specialties now form different profiles within this single standard. To achieve the goals of the new paradigm in higher education, special "didactical groups" from different civil engineering universities were formed, which created the so-called "basic part" of bachelor standards, which are obligatory for all universities, and the "variable parts", which correspond to specialities in civil engineering already existing in Russian universities. This arrangement was necessary from three points of view: first, we tried to save traditions in civil engineering education, second, it is very difficult (practically impossible) to “turn over” the minds of academic staff, who recognize only the five-year Engineering education Diploma, and third, the employers should understand “who is who”, i.e. the correspondence of each Bachelors profile with existing specialities. These difficulties were addressed by an optimized structure of the educational programs, according to which the basic part of bachelor programs does not exceed 50 % of the total curriculum, while in master programs it does not exceed 30 %. This arrangement allows all the existing civil engineering specialties to be unified under a single program, i.e., the Bachelor in Civil Engineering. At the same time, such a structure gives Universities flexibility in creating their own variations of civil engineering programs, which take into account local features and employer requirements.

KEYWORDS

Civil engineering education, Bologna process, Educational standards, Bachelor program, Master program, Basic part, Variable part.

GRADUATE AND MASTER CURRICULA IN THE FIELD OF CIVIL ENGINEERING AT ESCOLA DE CAMINS OF UPC (SPAIN)

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This paper describes the degree and master curricula that are being implemented at *Escola de Camins* (UPC) in Barcelona. This new organization of the studies is motivated by the European convergence in the education at the university level. One of the convergence points is the ECTS (equivalent credit transfer system) in which the subjects and blocks are described.

The new curricula are developed following the structure proposed in Spain which consists of four year degrees followed by one or two year master degrees. In order to satisfy the different interests and skills of students, three different degrees have been implemented at Escola de Camins, namely Civil, Construction and Geological Engineering. Master studies corresponding to different thematic areas of specialization are also in place, as well as the corresponding doctorate studies. Masters, with the professional qualification, are still under design and will be implemented as the newly graduated reach the point to enter the master studies.

The CaminsOpenCourseWare is a newly developed platform to prepare the programs of the different courses forming the degree and master programs. It is based on the concept of competences acquired by the students in each subject or course, and it also permits to describe in more detail the way the course is organized, what is the support material to be used, how the evaluation will be done, and any other aspects of the course organization.

Session 4

PhD Studies

DEVELOPMENT AND IMPLEMENTATION OF A POSTGRADUATE COURSE ON RESEARCH METHODOLOGY FOR ENGINEERS AND SCIENTISTS

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With an overall aim to contribute to the ongoing discussion of improvements and reforms in doctoral programmes worldwide, the present paper focuses on the development and implementation issues of a postgraduate course administered by the Department of Civil Engineering of the Aristotle University of Thessaloniki in Greece. The course is compulsory for all doctoral students and also for the students of the MSc postgraduate programme "Environmental Protection and Sustainable Development" of the Department.

The main purpose of the course, which is provided during the last six academic years, is the familiarisation of the postgraduate students with the basic principles of research (objectives, means, methods, conduct and results) together with the development of appropriate relevant skills The principal objectives of the course are those that make the postgraduate students, after its successful completion, capable of: recognising the main features of science, engineering and technology, being familiar with the scientific methods of research, identifying the processes and the final approach to the design and implementation of a research project, accepting all ethical rules in conducting scientific research, carrying-out efficiently a literature survey, using terminology standards and glossaries and applying good practices in definition giving and term rendering, presenting the results of their research in oral and written form, and selecting and composing their material for presentation through slides and posters.

In the paper all issues mentioned above are discussed from the perspective of the two main categories of the course's learning objectives/outcomes aiming at: (a) acquiring knowledge on critical research-related issues (knowledge outcomes), and (b) developing transferable and personal skills necessary in practicing research, but also for career development (skills outcomes). Particular points that are emphasised in the paper include the multilevel

educational structure of the course, the contents of the lectures, and the requirements for assignments undertaken by the postgraduate students, which aim at building research competencies and developing communication skills. Finally, the fact that the course is provided to a class, which is composed of graduates originating from a wide spectrum of disciplines, is also examined. It is apparent that, due to this discipline-mix of the class, the synergies developed between civil engineers and graduates from other engineering and science fields, either by taking part in the classroom activities or in preparing the assignments, form an additional positive characteristic of the course.

KEYWORDS

Civil engineering, Postgraduate course, Research methodology, Skills development, Course assignments

EUGENE: AN LLP ACADEMIC NETWORK FOR ENGINEERING EDUCATION

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Engineering and Engineering Education (EE) play an important role in the development of Europe. The opening of European EE to the world is a challenge for engineering academic institutions all over Europe. Yet, there are a lot of issues to be addressed. Among them are competitiveness, innovation and attractiveness of engineering education and especially of PhD training. These issues are closely linked with the emerging field of engineering education research and with the mobility, both within Europe and in a global scale of engineering students, graduates and professionals but also with lifelong learning and continuing engineering education. All the above issues demand close cooperation between European engineering academic institutions involving also industrial stakeholders. The Lifelong Learning Programme (LLP) Academic Network in the field of Engineering Education "EUGENE-EUropean and Global ENgineering Education" (October 2009 to September 2012) is an attempt to study all the above subjects. This is done through the five Activity Lines and the three Transversal Activities of the project: **Line A**-Structure and Bologna follow-up in the competitiveness issues of PhD studies, **Line B**-Promoting EE in Europe as a true research field, **Line C**-Improving transnational mobility of engineering students, graduates and professionals, **Line D**-Life Long Learning & continuing education as a tool to improve competitiveness and innovation of European engineers**, Line E**-Increase attractiveness of studies in science and engineering and to the European Higher Education Area**, TA 1**-Direct involvement of industrial stakeholders, **TA 2**-Promote the establishment of the standing European Engineering Deans Council, **TA 3**-Identify and put in practice sustainability tools beyond the 3 years of life of the project.

The 78 partners of EUGENE come from 32 countries. In addition, there are 6 associate partners from 4 other countries. Partners are not only higher education institutions but also engineering societies and associations like IFEES, SEFI, CESAER, EUCEET and APE, quality assurance institutions like

ASIIN, ENAEE and CTI and companies like Dassault Systèmes and Hewlett-Packard.

KEYWORDS

LLP ERASMUS Academic Network, Engineering Education, European Higher Education Area, EUGENE

DOCTORAL STUDIES QUALITY ASSURANCE AT UNIVERSITY OF RIJEKA WITH EMPHASIS ON STUDIES IN CIVIL ENGINEERING

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During 2005 all study programmes at Croatian universities underwent reforms according to Bologna declaration. Within the changes, the existing university postgraduate doctoral studies were reformed and the new ones started. There are 11 active postgraduate doctoral studies at the University of Rijeka today, among which the postgraduate university doctoral study of Civil Engineering performed by the Faculty of Civil Engineering was also started in 2005.

In order to assure the quality of doctoral studies and increase the doctoral studies completion rate at the University of Rijeka, the Postgraduate Studies Evaluation Board together with the Centre for Science and Centre for Quality Improvement of University of Rijeka has made the assessment plan for all doctoral studies and conducted the doctoral studies implementation evaluation at the University of Rijeka. The evaluation was based on self-evaluation report, doctoral student surveying and doctoral studies development plan.

This paper specially refers to the evaluation of university postgraduate doctoral studies at the Faculty of Civil Engineering, University of Rijeka, as well as to the recommendations made in order to improve this study. In implementing the doctoral studies evaluation, the Faculty of Civil Engineering has recognized the possibility of a systematic quality analysis of this study, the results of which are the base for its improvement.

In our opinion, the doctoral studies evaluation model established at the University of Rijeka and the experience made during the implementation at the Faculty of Civil Engineering are worth presenting to the representatives of facilities engaged in education of civil engineers as an example of good practice.

KEYWORDS

Bologna declaration, Study programme reform, Postgraduate university doctoral study, Evaluation, Postgraduate doctoral study of civil engineering

DOCTORAL STUDIES: IMPLEMENTATION AND PERFORMANCE OF EDUCATION AND RESEARCH PROGRAM AT THE FACULTY OF CONSTRUCTION MANAGEMENT IN BELGRADE

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The preparations and later implementations of the Bologna process at universities in Serbia started at the beginning of the last decade. Apparently, this process was the most slowly developed in the field of doctoral education. Possible reasons for this could be concerned with the low interest of civil engineering students for pursuing the PhD studies from the practical standpoint as well as changes in the evaluation systems and requirements addressed to academic staff supposed to carry out the curriculum and mentorship. In addition, better relations and cooperation between faculties and scientific and R&D institutes must be established dealing with PhD courses. However, doctoral studies in Serbia are on their way to define integrative framework comprising research and education. The Faculty of Construction Management is one of the two civil engineering faculties in Belgrade which has been accredited for PhD program by Serbian Ministry of Education and Science. In order to provide students with the state-of-the-art knowledge and various research topics, several prominent professors who are leading experts in their fields are engaged from universities in USA and UK. Distance problem considering that students and professors live in the different states has been overcome by the use of the latest ICT approaches. The aim of this paper is to present the conceptual and organizational aspects of the doctoral studies at The Faculty of Construction Management with implementation of new teaching and learning technologies based on IP and up-to-date software tools. Special efforts have been made to include the best PhD students in scientific and R&D projects supported by Serbian Ministry of Science and Technological Development. There is considerable interest to participate in European FP6 and FP7 programs as well as in bilateral cooperation with universities in neighbor countries. Young researchers have been stimulated to publish

investigation results under the leadership of their mentors. For the sake of illustration, PhD course topics in structural engineering are presented with the emphasis on curriculum, implementation of new technologies in teaching and learning, and inclusion of PhD students in scientific and R&D projects.

KEYWORDS

Civil engineering, Doctoral studies, Education and research, New teaching and learning technologies.

Session 5

Civil Engineering Curricula: Old and New

ENDURING CONSTITUENTS OF CIVIL ENGINEERING CURRICULA: EDUCATIONAL FIELD TRIPS AND DIPLOMA THESIS

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While calls for educational reform are frequent, there is a lack of systematic discussion on the forces that do or should change engineering curricula. Likewise, whereas some time-honored teaching practices, such as lecturing to largely passive audiences, are being questioned, there is a lack of systematic argumentation on the types of traditional educational experiences that are uniquely valuable and, hence, worth preserving. Considering the two issues of what should or should not change to be the two sides of the same coin, this article first describes four categories of potential forces for change relevant to engineering curricula, namely (i) technological advances, (ii) societal demands, (iii) industry needs and (iv) educational good practices and advances, i.e. advances in instructional technology and engineering education research.

Within the fourth category, educational good practices, the article attempts to identify characteristics of curricula constituents of high learning value, which are *not* candidates of replacement by instructional technology. From the educational experiences that fall in the category of "Advance Personalized Learning", the article focuses on research or research-like experiences, the educational value of which has been documented with evidence. It then presents two such educational experiences from the civil engineering curriculum at the National Technical University of Athens (NTUA), the annual geoengineering field trip and the diploma thesis. The field trip is designed for civil engineering students who need to appreciate the importance of engineering geology in the design decisions concerning civil engineering infrastructure. From the perspective of educational theory, the trip belongs in the tradition of inductive teaching: students are not simply shown the geological features that they should be observing, but instead are presented with a design problem and guided to identify themselves the pertinent geology and rock mechanics data. The diploma thesis helps students develop research skills and exercise autonomy. Data collected at NTUA showed that diploma

theses frequently produce original findings, as attested by the number of publications resulting from or including thesis material.

Needs for further work are related to the following observations. The indirect evidence pointing to the success of the two educational experiences notwithstanding, assessment of skills developed by students as a result of engaging in these activities is missing. Hence, it is necessary to gather targeted data, which will enable evidence-based justification of preserving curricular elements on the basis of the skills they promote. In addition, since both educational experiences are faculty-time intensive, their presentation is meant to underscore the need to steer the development of instructional technology towards instructional tools that will free faculty time to be devoted to time-consuming educational activities that technology cannot replace.

KEYWORDS

Engineering education, Engineering curricula, Engineering instruction, Engineering Geology, Undergraduate research

THE VISUAL IMPACT ISSUE IN THE CIVIL ENGINEERING CURRICULUM

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In 2000, the EU released the "European Landscape Convention". In February of 2008 the EU Committee of Ministers issued a more comprehensive document developing the guidelines for the implementation of the European Landscape Convention. In terms of the civil engineering infrastructures design, this document consolidates the need to know how to assess the visual intrusion that such design is going to produce on the landscape. This task is integrated within the corresponding Environmental Impact Assessment.

When a civil engineering infrastructure is projected, its effect can be predicted and expressed as the result of having analysed two essential factors (landscape and population) and having combined two assessments (one subjective, the other objective). They tend to be called visual intrusion intensity (the former) and visual impact magnitude (the latter). It is common to assist the intensity assessment with computer-graphic simulators, and more or less sophisticated virtual reality, as well as to formulate the magnitude with numeric indicators, derived from a calculation process which does not differ too much from the ones used to study other elements of the project.

At the Civil Engineering School of Santander, the assessment of visual impact has been a matter of research since the year 2000, and it has been a post-graduate master level course since the year 2006. The purpose of this study is to describe the scientific, technical and technological scope of its content, outlining its most noteworthy educational elements and forms.

The study will also briefly refer the proprietary tools developed to evaluate visual impact, both in their numeric and in their graphic aspects.

KEYWORDS

VIA, Visual impact assessment, LIA, Landscape impact assessment, EIA, Environmental impact assessment, MOYSES® v4.0, CANTAVIA® v1.0.

INCORPORATION OF NANOTECHNOLOGY IN THE CURRICULUM OF CIVIL ENGINEERING EDUCATION

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Nanotechnology and nanoscience are scientific and technological fields that have attracted considerable interest in the last decade. Both deal with the science and technology at a scale smaller than 100nm (1nm=10^{-9}m). Due to their reduced size, nanomaterials properties vary considerably from those of bulk materials and thus they present exceptional mechanical, optical, magnetic and electric properties (Schaefer 2010). Applications to everyday life are increasing as well as the domains of applications.

Civil Engineering is not excluded from applications of nanotechnology. Applications include super-hydrophobic surface treatment in order to increase materials durability, self healing materials in order to reduced crack propagation, Micro-Electro-Mechanical Systems (MEMS) and Nano-Electro-Mechanical Systems (NEMS) for monitoring of structures with non-destructive methods, nano-cement and nano-steel for increased strength and durability, just to mention a few (Nanoforum Report 2006, Sobolev et al. 2006). Nanotechnology applications seem also very promising in environmental applications, a field in which Civil Engineers are increasingly involved (Observatory Nano 2010). The financial interest is demonstrated by the increased amount of budgets invested in nanotechnology research and development, a significant part of which is directed to the domain of tailor-made materials properties, while the scientific interest is demonstrated by the increasing rate of scientific publications, which originate from the fields of physics, chemistry and materials science and seem to involve an increasing number of civil engineers (Economidis 2010).

The need for better understanding of materials properties at the nanoscale and their use in application in engineering and more specifically in Civil Engineering is a special concern (ASCE 2007, Kim et al. 2006). It is also demonstrated by actions taken by the National Science Foundation (NSF) in the United States (US) for Civil Engineering Departments to introduce nanotechnology courses in their curriculum (Zheng et al. 2010).

In the present paper we discuss the need for the introduction of nanoscience and nanotechnology courses with relation to the syllabus as well as to pedagogical points where attention should be paid in order to achieve the best output. Understanding the difference of behaviour of nanomaterials and their importance on materials' behaviour will provide future Civil Engineers with advanced skills that will enable them to adopt emerging technologies and formulate innovative solutions to complex problems. Such skills will provide students with additional professional opportunities and competitiveness in the international economic and scientific environment.

KEYWORDS

Nanoscience, Nanotechnology, Civil engineering education, Civil engineering curriculum.

HOW TO WORK WITH CURVED STRUCTURES: THEORY

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Teaching of structural mechanics – or mechanics generally - is traditionally an extremely challenging task. Curved structures particularly have proven to be frightening for the students. For "straight" structural members the basis unit vectors applied can be kept as constants. Usually simple figures describing a material element in the original and in the deformed state produce rather straightforwardly the required strain expressions. Similarly, simple free body diagrams for the material element are enough to give the local equilibrium equations and the traction boundary conditions.

Curved structures need to be described initially in curvilinear coordinates. The unit basis vectors are then no more constants but depend on the position. This is one major complication as compared to the straight case. Perhaps a still more serious difficulty concerns the use of figures and diagrams to produce the strains and equilibrium equations. The figures and diagrams tend to become so involved that a doubt about the correctness of the deductions can easily emerge in the mind of the student. A general unifying background theory is easily lost as more or less ad hoc figures are employed in each new structural case. Further, if large deformation problems are considered, correct deductions in this way are in practice out of the question. Of course, tensor calculus in curvilinear coordinates solves these problems elegantly, but this approach is quite too demanding in time and effort to be used in basic structural mechanics courses.

An approach which produces the relevant expression in curvilinear orthogonal coordinates without tensor calculus is described in the paper. The approach is called "the method of local Cartesian frame". The main idea is: if we have an expression valid in rectangular Cartesian coordinates, a corresponding expression for curvilinear orthogonal coordinates can be formed in simple steps. Explaining the steps to the students does not demand too much effort. A general theory is described in the paper. For instance gradient and divergence expression and general small deformation strain expressions in two dimensions are developed. No figures describing the material element in the initial and deformed state are used. Again, such figures are fine in simple straight structure applications but are, in our opinion, not convincing enough in curved cases.

The equilibrium equations for curved structures are not derived here directly by the method of local Cartesian frame although this can be done. Alternatively, after the strains have been arrived at, the principle of virtual work is used for this purpose. The importance of the principle of virtual work in structural mechanics cannot be overemphasized. It unifies analytical and numerical approaches - especially the finite element method. Here with curved structures it is employed to derive the local equilibrium equations and traction boundary conditions. The invariance properties of the internal and external virtual work are employed when using the method of a local Cartesian frame. Integration by parts operations are needed in the manipulations. No free body diagrams are applied.

KEYWORDS

Teaching techniques for mechanics, Curved structures, The method of local cartesian frame, Principle of virtual work.

HOW TO WORK WITH CURVED STRUCTURES: APPLICATIONS

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This is a companion paper to the one titled: How to work with curved structures; theory. The general theory is presented in the cited paper. In the present paper two specific example applications are given in detail. Provided that the main ingredients in the method of local Cartesian frame for curved structures are explained in the theory paper, we here just shortly describe the two applications.

The first application concerns the analysis of a circular disk. Polar coordinates are employed. The conventional procedure applied in textbooks in this case is again based on carefully drawn figures showing the initial and deformed geometry for a small material element. Deducing the relevant expressions from the figures demands rather careful interpretations. Our approach is based on the use of a local Cartesian frame. Further, after the strains have been determined, the local equilibrium equations and the traction boundary conditions are arrived at by employing the principle of virtual work. Integration by parts in two dimensions is needed in the manipulations. This part of mathematics may be somewhat unfamiliar to the students. However, in introducing the most important principle of virtual work in general, integration by parts must be mastered, so this should not be a grave problem.

The second application concerns the analysis of a circular beam in two loading cases. Emphasis is placed on the importance of the corresponding kinematic assumptions. The curvilinear coordinates are now the beam axis arc length and two rectangular axes perpendicular to the beam axis. To determine the strains correctly from figures describing the geometry in the original and in the deformed state seems to us as a nearly impossible task. The method of local Cartesian frame works easily. In the equilibrium equations derivation, which is based on the principle of virtual work, integration by parts is needed only in one dimension. This tool should be already rather familiar to the students.

The meaning of the papers considered, is not just to derive the basic equations of classical mechanics, but to derive them in a systematic way students can easier assimilate. According to the feedback of students, it is obvious that even the complicated equations of the shell theory have got a novel role, when the background of each term will get a clear physical meaning.

Other concepts based on various kinematical assumptions, such as sectorial coordinate with thin-walled structures, may be derived simply as well.

KEYWORDS

Teaching techniques for mechanics, Curved structures, Circular disk, Circular beam

Session 6

Qualifications, Accreditation, Assessment

EFFECT OF TEACHING ACTIVITY EVALUATION IN THE ENGINEERING EDUCATION QUALITY

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The main objective of this paper is to prove the positive effect that teaching activity evaluation of university professors has on the quality of engineering education. This conclusion can be obtained after an analysis of six years of experience in the Escuela de Ingenieros de Caminos at the Technical University of Madrid.

Professor´s evaluation in Spain was introduced in 1983 with the University Reform Law (Ley de Reforma Universitaria, LRU), focusing separately on the teaching and research activities of the professor. However, while the research activity evaluation was delegated to a national commission (Comisión Nacional Evaluadora de la Actividad Investigadora, CNEAI) according to a general procedure, the teaching activity evaluation was delegated to each University by their own rules. Unfortunately, most of the Spanish universities gave no enough relevance to teaching evaluation and, of course, there was no standard procedure to perform this evaluation. In most cases, the teaching evaluation was traditionally conducted by students' unions. The usual procedure was a paper form given to students who were attending lectures on a given day near the end of the term. The results had all type of errors: arithmetic, confusion among subjects and among professors, lost data, etc. Finally, dissemination of evaluation results was forbidden and limited to the professor himself and, eventually, to the Director of his Department.

In 2005, the Escuela de Ingenieros de Caminos (School of Civil Engineers) developed a new on-line system for teaching activity evaluation. This system was immediately accepted by the students and their participation has been growing since then. Faculty were, with few exceptions, collaborative, interested and satisfied with the procedure. The evaluation results were exposed publicly (of course, within the limits of the Spanish Data Protection Law). The system has been carried out from the academic years 2005-2006 to 2009-2010.

By analysing the results of the evaluation in these years, it can be concluded that there has been a general improvement of the quality of teaching, and that one of the main reasons for that has been the public dissemination of results, since professors are more prone to make an effort to improve their own results, and consequently the quality of their teaching. This effect is most evident in younger and non-staff professors. The reasons are twofold; firstly they improve as they get the feedback of their teaching activity and can compare it with the results obtained by their colleagues and, secondly, they improve due to the necessity to get good qualifications to become permanent university employees.

KEYWORDS

Teaching activity evaluation, Professor evaluation, Teaching survey

QUALITY ASSESSMENT IN ENGINEERING EDUCATION IN SPAIN: TOWARDS A NEW ACCREDITATION AGENCY

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Engineering programs have special characteristics within the university systems in many European countries, mainly because the close relationship between their academic programs and university degrees, and their increasingly demanding careers. This has become more important following the adoption of the Bologna Process, in which university education is now organized in two levels, bachelor and master. In addition, the social changes associated with a switch from an industrial to a knowledge economy is also a factor, as in the increasingly role of technology in society.

Quality in higher education is a complex matter and it gets more complicated when education and accreditation systems depend on Governments. In these circumstances, even if the entities responsible for quality assurance try to work independently, their decisions may collide with the interests of the governmental entity responsible for the global education system. Within higher education, the accreditation entities and the regulatory administration may have conflicting perspectives, causing problems for the functioning of the education system. Experience shows that in these cases the entities responsible for the quality of university systems must give valid answers to all the different academic fields involved through general processes and mechanisms in which all the particularities are included. Furthermore, this dependence on Governments prevents the accreditation entities from signing international agreements for multilateral recognition with other prestigious organizations.

Engineering programs in Spain are facing some contradictions despite their reputation, in particular, insufficient academic and professional recognition. Accordingly, some Spanish universities are now seeking ABET accreditation for their engineering programs, which may involve additional costs, internal

imbalance, competition between centers and availability of specific study programs. In this paper some thought is given to the possibility of creating an accreditation agency for engineering programs in Spain within the EURO-ACE framework. Its compatibility with the Spanish legislation, its acceptance and possible integration with university and professional systems are analyzed. This is carried out within the European ENAEE network that has not been introduced in Spain yet, maybe due to the particular Spanish structure of the quality and accreditation system with regional agencies.

KEYWORDS

Quality Assessment, Academic and Professional Recognition and Accreditation, Evaluation and Accreditation Agencies

THE ROLE OF THE AUDIT PROGRAM IN THE INTERNAL QUALITY ASSURANCE SYSTEMS AS MOTOR OF THE TECHNICAL LEARNING PROCESS ADAPTATION FOR EUROPEAN SPACE FOR HIGHER EDUCATION (ESHE): AN OPPORTUNITY TO RESTART THE SYSTEM

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The so-called “Bologna Process” has raised a set of new challenges for the University System that will emerge as essential characteristics of the European University system from now on. This situation will be especially important for the evolution of engineering studies subject to a renovation process that has been increasingly speeding up in the last twenty years. Firstly, new issues have to be included in programs and lectures, secondly some methodological changes are needed to adapt to XXIst Century learning processes and instruments, thirdly the present state of knowledge in the different subjects has to be considered, fourthly the business model has to be redefined by the university, and finally the university products, whether degree or R+D research, have to be reorganized too.

All these processes require a professional staff of managers in the university system that currently does not exist, and a consistent analytical system has to be created in order to conduct the broad and intense decision process needed to adequately pilot this revolutionary change. To guarantee a relative success, a common exigency has been included in the definition of the applied educational policy: the general implementation of an Internal Quality Assurance System (IQAS), as a key instrument for aligning all the efforts involved in the strengthening of the university system.

With this aim, Spanish Public Agency ANECA has developed a set of useful instruments to provide the university with guidelines and procedures for the implementation of a robust framework for the future strategic evolution of the university. Among them, the AUDIT program represents a key issue created to help the Universities and Schools in the process of defining their new strategic adaptation to the European Space for Higher Education (ESHE). This program is an open instrument for each Center to adopt, which initiates a process for qualifying and certifying its quality assurance systems and which represents the highest scale in compromise with official quality exigencies at the present.

The aim of this paper is to analyze the implication of the AUDIT for the strategic evolution of “ETS de Ingenieros de Caminos Canales y Puertos” at the University of Cantabria. The paper is organized as follows. First we start with a review of the Audit Systems procedures and requirements, then we review the specific issues that have emerged through the implementation process, and third we describe the final framework adopted. Conclusions about the value added by the system and the evolutionary paths initiated are then derived.

KEYWORDS

Quality assurance, Integration policy, Evolutionary paths, University management

GERMAN STUDY PROGRAM ACCREDITATION AT DEAD END?

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The Bologna Process, with its comprehensive change in study structures all over Europe, was the starting point for a detailed quality assessment in which accreditation as an external quality assurance method plays a major role. Under the guise of safeguarding the quality, year by year German universities spend enormous sums of money for quality assurance, especially for the accreditation of the universities' bachelor and master programs. Universities feel impelled to develop curricula for study programs based on the guidelines of the accreditation agencies to get a successful accreditation. But is the system of accreditation really necessary and helpful to improve the quality of study programs at universities? And furthermore, is it in conformity with the German Law?

The paper offers a closer look at the development of accreditation as a quality assurance system. Furthermore, the accreditation system in Germany is described by using the example of the accreditation of civil engineering programs. In the fourth part, the legal basis of accreditation under German law is analyzed. Among other things the violation of basic rights by the accreditation processes, especially the university professors' Freedom of Free Teaching, enshrined in the Freedom of Sciences, is discussed.

The conclusion of these analyses is that the German system of accreditation is not reasonable. Furthermore, in the authors' opinion, it has no legal basis under the German Law in force and does not meet the requirements of Article 5.3 sentence 1 Basic Law of the Federal Republic of Germany, in which the Freedom of Sciences is fixed. This would mean that there is no legitimate obligation under German law to bring the universities' bachelor and master programs under the accreditation process at this point in time. Due to a constitutional complaint of a German university, the German Federal Constitutional Court is currently involved with the question of whether the system of accreditation is in conformity with the German Constitutional Law or not. The importance of the decision is obvious: if the Court decides that

accreditation is unconstitutional, it allows German universities to be much more independent in developing curricula for civil engineering programs without conforming to the guidelines given by the accreditation agencies. This would be important in relation to European competition for the best students. Thus, the result of the decision may have an influence on the European idea of common standards and procedures for accreditation.

KEYWORDS

Bologna process, Accreditation, Freedom of teaching, Civil engineering programs

GREEK UNIVERSITIES AT A CROSS-ROAD: HOW CAN THEIR DECLINE BE REVERSED

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It has been widely admitted by everyone who has some knowledge about the Greek Universities that in the past few decades the quality of their output is in a continuous decline, no matter which index is used to measure such output. This observation is shared both by faculty and students alike, as well as by large sectors of the Greek society. In this paper we present a very brief review of the basic changes that were introduced in the Universities back in 1983, when the old system, a copy of the German Chair based system, was changed by a law written with the American University system in mind. The main changes introduced by that law included the abolishment of "Chairs", the introduction of the Departmental Divisions, the four grades of faculty members, the large representation of students in the electoral bodies for elections of the University officials (rectors, vice rectors, deans, Department Heads, Division and laboratory Heads) and the large percentage of students in the Department General Assembly, which governs the Department.

Subsequently, the problems of today attributed to this law or to misapplication of the law or to other factors related to Greek society in general are presented and discussed, starting with the two main causes from which these problems originate: one political and the other associated with the university itself. The political or better partisan factor entered into university affairs through politically controlled student unions which designate the very high numbers of student representatives, not only to the electoral bodies for university officers but also to the administrative bodies, e.g. the Senate and the Departmental General assemblies. Consequences of this are: (a) Not to elect the best people in the various university posts, (b) The Committee responsible for temporarily "lifting the asylon" and for asking the police to intervene in case that criminal acts are committed in the University, is never formed since the student unions refrain from designating the student member to the Committee, (c) Blocking of important decisions like, e.g., establishing lists of prerequisites, abolishing the "automatic" student enrollment in any term without some minimum requirements etc. The second cause is associated with a non negligible number of university professors who favor the existing state of affairs and indirectly support or at least do not react when any minority decides to take over a university building or the whole university and close it, usually to protest about something. The same group strongly reacts not only to the creation of private universities in Greece but also to any proposal that would help exiting from the present crisis.

To reverse the decline it is proposed that a new law should include the following provisions:

1. The fundamental right of students to attend classes without any obstacle and of the professor to teach and do his research must be protected and secured by penalizing the taking over of university buildings by anyone. Persons violating this right, including University officers who do not carry out their duty to use ALL the provisions of the Law to secure this right, should be held accountable. This implies drastic reform of the existing "asylon" provisions.
2. Drastic reduction of the student representation in the electoral as well as the administrative bodies of the university.
3. Departments in which course prerequisites are not introduced should not be allowed to give degrees.
4. Establish firm requirements for a student to register in each Semester (e.g. minimum and maximum number of courses he is permitted to register for).
5. Establish rational procedures for course exams and conditions under which a student should not be allowed to continue his studies.
6. Establishment of new procedures for election of University officers (Rector and Vice Rectors) and Department Heads.
7. Grant greater authority to the Rector, Vice Rectors and to Department Heads for a number of academic matters, including disciplinary action in cases of violations of the Law or the University rules and code of ethics by students and faculty.
8. Restriction of the Senate role to strategic planning and to major issues only, by transferring administrative matters and pertinent decisions to the Rector and Vice Rectors. Do the same for the Department General Assemblies and delegate more authority to the Department Chairman and the Division Heads.
9. The Ministry of Education should grant greater autonomy to the Universities, reduce the bureaucracy and keep for itself only the role of oversight, for making sure that there are no violations of the Law by anyone.

10. Re-examination and possible revision of the criteria and procedures for election, promotion and granting of tenure to faculty members, giving as much emphasis to teaching as to research and publications. Establishment of periodic evaluation of all faculty members at every level.

Finally we conclude by outlining how the required changes can be implemented in a way that they will not be short lived, as it has often happened with similar attempts in the past.

KEYWORDS

University, Chair, Decline, Student participation, Administration, Rector, Department, Taking over by students, Accountability, Law revision, Required changes

ON HIGHER CIVIL ENGINEERING EDUCATION IN RUSSIA: A CASE OF A MASTER'S DEGREE ON STRUCTURE RELIABILITY & SAFETY

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Transition to the tiered system of education in Russia poses a workload problem for teachers, as it is associated with an increase in the number of master's programs related to the modern problems in construction. One of such problems is the safety and reliability of design of buildings in emergency situations, either man-made or natural. These problems are particularly relevant, considering the recent devastating earthquakes, tsunamis, numerous acts of terrorism, fires and other emergency situations. Moscow State University of Civil Engineering has developed a master's degree program on the subject of the "Reliability and safety of building constructions", aimed at training of experts in the analysis, in computational and experimental modeling, as well as in the development of building codes and standards for design and construction in special circumstances.

The developed master's program meets Federal State educational standard of Master in the field of "Construction", approved by the Ministry of Education and Science of the Russian Federation. The structure of the standard stipulates a percentage of about 30% of compulsory subjects (18 - 20 credits) for all master's programs in this field. The remainder, i.e. about 70% (40 - 42 credits), of the program consists of special courses reflecting the content of training for each individual program. Finally, 60 credits are allocated for research work and state certification. This masters program is described in Section 1 of this article.

In preparation for Masters, 8 of 10 special disciplines are required, while 2 of 4 subjects are optional. Optional disciplines permit students to advance their knowledge in topics such as general mechanics as well as numerical and experimental methods for mechanics of deformable solids. In Sections 2 to 9, the article gives a summary of the following eight disciplines of the aforementioned master's program "Reliability and safety of building constructions", as they are taught in this particular program:

• reliability and safety of technical systems, man-made risk;
• theory of reliability of structures;
• theory of seismic stability of structures;
• fire and explosion safety of structures;
• loads and effects on buildings and structures;
• design codes in civil engineering;
• multifactor structural analysis;
• structural survey and research.

KEYWORDS

Civil engineering education, Reliability, Man-made risk, Construction codes, Testing facilities, Earthquake resistance