The Interface

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The Interface's Change of Face…

by Rob Reilly, Editor

All who knew Bill Sayle will know that he was a model as a professor, a colleague and as a human being. All who knew Bill have fond memories of him. *The Interface* has not been published since Bill's untimely passing. While Bill was still with-us, there were a number of issues on the table for this publication. The primary issues were: 1. having *The Interface* in electronic format as opposed to paper-only format. The paper format was a severe drain on the ASEE ECE Division's budget, and 2. utilizing *The Interface* as a vehicle for scholarly discussion of timely topics in addition to the organizational reports.

I believe that we can address several of the major concerns and can provide a better publication. In moving toward new horizons, my first goal is to have a top quality editorial board. This board will consist of associate editors and advisers. The associate editors will be involved in the solicitation and final selection of articles and proofreading. The advisers (and the associate editors) will provide: critiques of each issue as needed, the general direction of the publication, and suggested topics for each issue.

I will ask specific people to create articles for each publication. I will also issue a general call for articles. The articles will not be empirical research papers, but will be conversational articles through which the author(s) will present an opinion on some topics of timely interest. I expect that some papers will challenge established thought while others will support established thought.

I hesitate to place a word count on papers. But the suggested range is from 250 words to 1,000 words. Generally speaking, 250 words do seem too brief to make a point and support an argument, and 1,000 may seem to be too many words, but that may be sufficient in some cases. And, as I mentioned previously, we expect that the papers will be conversational rather than strictly empirical.

In short, the author(s) of the articles should attempt to convey the readership why they should be interested in a given topic/issue, or why the readership should not be interested in a given topic/issue. I imagine *The Interface* will be a forum for scholarly commentary on all sides of various issues that confront our profession on the academic side as well as the industry side.

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Influence of the Bologna Accord in Software Engineering Curriculum Development

by Ricardo J. Machado and João M. Fernandes

Nowadays, being a software engineer requires not only mastering a programming language, but also acquires know-hows in several technical and managerial topics. Current curricula in software engineering must include modern technical topics (such as open-source software development, service–oriented architectures, integration with legacy systems, usage of components and libraries, model-driven development, software methods for embedded and pervasive systems, and construction of web-based applications) and also other competencies (such as software process, software method, project management, and organizational issues). Curriculum development should formally consider the recommendations existing in the Software Engineering 2004 and GSwERC Curricula Guidelines and the Knowledge Areas described in the SWEBOK.

Meanwhile, in the European Union (EU), another educational framework has appeared, which conditions curriculum development in higher education. In June 1999, 29 European ministers in charge of higher education met in Bologna (Italy) to lay the basis for establishing a European Higher Education Area by 2010 and promoting the European system of higher education worldwide. In the Bologna Declaration, the ministers affirmed their intention: (1) to adopt a system of easily readable and comparable degrees; (2) to adopt a system with two main cycles (undergraduate and graduate); (3) to establish a system of credits (such as ECTS, the European Credit Transfer and Accumulation System); (4) to promote mobility by overcoming obstacles; (5) to promote European co-operation in quality assurance; (6) to promote European dimensions in higher education. Since then, across Europe, a great number of Computing departments have been concerned with the process of restructuring their curricula, according to the Bologna declaration. We believe that formal and in-depth software engineering education should occur only at the graduate level (second cycle of Bologna, equivalent to U.S. Master's level) to software development professionals with a first degree in computing (first cycle of Bologna, equivalent to U.S. Baccalaureate) and some experience (ideally, three years minimum) in developing software solutions in real world (industrial) contexts. The software engineering curriculum should, therefore, concentrate on topics that were not taught during the first degree in computing and that can have a positive impact on the professionals' daily practice. This recommendation is based on the analysis that software developers, after leaving university in the end of the first degree, are generally not prepared to perform all software engineering tasks required in industrial contexts. Typically, after three to five years of employment in software development, professionals realize that they need structured insights into specific software engineering topics. Until this point, topics such as requirements engineering, project management, and quality are typically not considered as important, because early-career software development professionals are essentially technology-driven. Those topics tend to be less technical than other software development activities, therefore, during the first degree, students and often faculty perceive those topics as less important than, for example, programming, testing, or design.

The learning outcomes of these software engineering curricula should be compatible with those defined for second-cycle academic degrees by the EU Dublin Descriptors that were adopted in the Bologna Process. These general descriptors are concerned with the following student competences: (1) knowledge and understanding, (2) applying knowledge and understanding, (3) making judgments, (4) communication skills, and (5) learning skills. These curricula should, therefore, be designed with explicit attention to the principles stated in the EU Bologna Declaration. Second-cycle curricula in software engineering designed to consider the principles stated in the Bologna Declaration could run in 4 semesters and consist of a total of 120 ECTS. The first year of the course could be divided in 2 modules of 30 ECTS and the second year could include either two 15 ECTS modules and an industrial project, or one 15 ECTS module and a research-oriented master dissertation. Each 30 ECTS module could include one curricular unit dedicated to the experimental integration of the module's specific curricular topics. These project oriented curricular units could be included to make the degree follow the project led engineering education (PLEE) paradigm.

Due to several causes (such as grading or lack of resources), many software engineering courses/degrees compromise the project experience by reducing the team sizes, project scope, and risk. The usual solution relies on dividing the students into small groups (2 to 4 persons), and making all the groups to solve the same software engineering project. We suggest introducing software engineering experimental curricular units, in which all students work together to develop a new software system, or to diagnose and analyze the process or the artifacts of a software system developed by third parties. This approach provides a more realistic project experience for the students and facilitates the participation of companies in the learning activities. This constitutes an important factor to ensure that students tackle modern industrial problems, reducing the gap between students and their potential future employers. This also solves, at least partially, the fact that educators rarely have the time required to manage real software projects in addition to their normal pedagogical duties. In fact, an important part of education in an academic setting is the practical application of concepts. The application of software engineering in the academic environment is quite different from software engineering in a professional context. In any case, it is the task of professors to provide realistic experiences to better prepare students for work in professional settings. Team-based projects are a well-known approach to motivate students by giving them the chance to participate in the type of work and environment that can be found in a software house. When such learning mechanism is adopted, it is reported that students can learn more about "real" software engineering. However, the usage of a format that resembles the context of a software house is more difficult to implement, which unfortunately makes it quite uncommon in software engineering education.

For curricular units based on projects, the software engineering degrees could promote a learning environment, in which students collaborate to develop a software product or to accomplish a process-related activity (analysis, design, implementation, test, maintenance, evolution, management), as if they were employees of a software house. Within the project, students could be organized in a simulated software development environment, with each student being responsible for specific individual and group tasks. Several issues that are not typical in a software engineering course (such as class-wide product brainstorming sessions, overlapping subgroups of students, distributed group working, weekly engineering meetings, and business and marketing strategic planning), aimed at releasing the finished product to the outside world, are possible solutions for emulating real industrial work contexts in software engineering curricula.

We believe that the general principles that have been discussed here about a two-year second-cycle curriculum in software engineering, aligned with the principles of the Bologna Declaration and also strongly influenced by the SWEBOK, the SE2004 and the GSwERC, ensure that the students acquire useful competences on a broad set of areas related to software engineering.

ABOUT THE AUTHORS

Ricardo J. Machado is a Senior Member of IEEE. He is a professor in the Departamento de Sistemas de informação at the Universidade do Minho 4800-058 in Guimarães, Portugal

João M. Fernandes is an IEEE Member. He is a professor in the Departamento de Informática at the Universidade do Minho 4710-057 in Braga, Portugal

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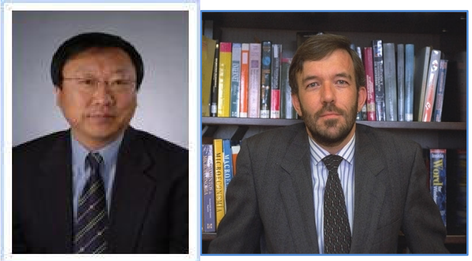

A Tale of Two Transformations in Engineering Education

by Young Moon and Alfonso Duran

One: Spanish Case with the Bologna Process

Engineering Education in many European countries including Spain is in the midst of one of the most significant transformations in their histories. After years of endless discussions, stalemate on the most controversial issues, and some false starts, various stakeholders such as governments, universities, and faculty members, are now rushing to meet the deadline for the implementation of the "European Higher Education Area (EHEA)." The so-called Bologna Process, aiming at the creation of a common EHEA by 2010, launched officially with the Bologna Joint Declaration of 29 European Ministers of Education on June 19, 1999. Since then, meetings of the Ministers of Education have been taking place every two years. Currently 46 countries belonging to the European Cultural Convention signed up for the Bologna Process.

Three priorities of the Bologna Process are:

1. Introduction of the three-cycle system (Bachelor / Master / Doctorate);
2. Quality assurance in accordance with 'the Standards and Guidelines for Quality Assurance' in the EHEA; and
3. Recognition of the requirements and durations of degree programs, in accordance with the Council of Europe/UNESCO Recognition Convention.

Additional key elements in the Bologna Process include:

1. a shift from instructor-centered teaching to student-centered active learning,
2. a focus shift from knowledge acquisition to development of skills and competences,
3. promotion of mobility including development of joint degrees, and
4. promotion of lifelong learning.

Within the general framework, specificities can be up to each country to define and develop. In Spain, adopting EHEA required a major redesign of the legal framework governing university degrees and regulated professions. As the initial attempt to overhaul the entire educational structure faced against fierce protests from various stakeholders, an alternative approach was chosen, whereby universities are free to propose whichever degrees they want (with the exception of some degrees subject to European guidelines, such as Medicine). With the EHEA deadline approaching, universities were given permission to start offering the new, EHEA-compliant degrees as of October 2008. The Carlos III University in Madrid is a forerunner in this process, having converted 80% of its engineering degrees in October 2008.

The transformation to the three-cycle engineering degree programs turned out to be most controversial. Bitter confrontations erupted between stakeholders of "higher" engineering degrees (i.e., those encompassing 5 or 6 academic years, and that on average required 7-8 years of full time study) and "technical" engineering degrees (i.e., those encompassing 3 academic years, and that on average required 5 years of full time study). As engineering degrees have traditionally been considered as an "elite" education in Spain, there is also a widespread suspicion that EHEA might result in losing the rigor required for engineering education. Furthermore, faculty members are concerned that their workloads may increase overwhelmingly with the introduction of continuous evaluation and other pedagogical changes. Students are also anxious about how they will be affected, and protests and demonstrations have been staged.

The pressure to move forward to meet the deadline created both negative and positive situations. For example, newly designed engineering degree programs started in Oct 2008 before the Government finalized the minimum educational requirements for these programs. As a result, these programs may require retrofitting to satisfy the governmental requirements. On the other hand, the simultaneous redesign of all degrees, coupled with autonomous authority given to individual university, offers a unique opportunity to exploit synergies among various degree programs. In the Carlos III University, this has led to more integrated, modular design of the engineering curricula where the creation of horizontal core subjects that span multiple engineering degree programs is realized.

Two: USA Case with the ABET EC2000

In United States of America, Engineering Schools and Colleges have been going through a major transformation with a comparable degree of impact by adopting new accreditation criteria called EC2000. Deployment of EC2000 criteria began in the late 1990s and now all the engineering programs in USA are being evaluated for accreditation under the new criteria. The transformation is not just confined within USA since an increasing number of engineering programs from different countries are seeking for recognition of "substantial equivalency" under a mutual recognition agreement called "Washington Accord." The signatories of the "Washington Accord" include the accreditation agencies from South Korea, Canada, South Africa, United Kingdom, Australia, Ireland, Hong Kong, Taiwan, Singapore, New Zealand, and Japan. A number of engineering programs from outside of the signatory countries also sought to obtain the "substantial equivalency" recognition.

Major changes that the adoption of EC2000 brought in can be summarized in three categories:

1. Emphasis on students' learning outcomes,
2. Accountability of individual programs in their quality assurance process, and
3. Broadened skill-sets for engineering graduates.

Under EC2000, what students know and can do is more important than what instructors teach. So-called 'a-k' program outcomes provide general guidelines regarding what educational outcomes each engineering graduate is expected to achieve by the time of their graduation. It is not sufficient to document that each program provided corresponding instructions on these subjects. Rather, each program is required to demonstrate that their graduates have achieved these outcomes.

While individual program now has a far greater autonomy and flexibility in defining their educational components (such as objectives, constituents, learning outcomes, and course contents), each program is held accountable for ensuring their educational quality. Faculty members in engineering programs in USA are engaged in shaping their unique programs as well as developing appropriate assessment and evaluation approach and tools to demonstrate they are continuously improving the quality of the programs. Before EC2000, engineering programs often complained about rigid requirements imposed by ABET. Now, the challenge is to develop and demonstrate that individual program has an effective system to ensure high quality and continuous improvement of its own program.

Half of the twelve program outcomes (a-k) deal with 'professional skill-sets' of engineering graduate such as communication skills, multidisciplinary teamwork, awareness of ethical responsibility, life-long learning, etc. In a sense, this is a statement that good engineers are those who possess these professional skills in addition to technical skills and knowledge. Such articulation of desired attributes of good engineers made gradual but certain impact on engineering education in USA.

As the deployment of EC2000 has been over a decade now, the concept seems to be better understood and accepted by majority of the engineering programs in USA. Certainly, there were confusions and oppositions to the transformation with similar suspicions that we observed in Spanish case. But the transformation seems to have settled in.

ABOUT THE AUTHORS

Young Moon is a professor at the Syracuse University, ybmoon@syr.edu. He is also a Visiting Professor at the Universidad Carlos III de Madrid

Alfonso Duran is a professor at the Universidad Carlos III de Madrid, Spain, duran@ing.uc3m.es

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News&Thoughts is an RSS feed that is intended to provide one-stop-viewing of aggregated high-quality Podcasts. This feed focuses on the nexus among engineering education, learning pedagogy (*i.e.*, for constructivism, for model-based knowledge domains), and emerging technologies that facilitate education (*i.e.*, storytelling, education, engineering, Blogs, PODcasting, wikis, digital delivery of content).

http://www.ewh.ieee.org/soc/es/rss1.html

Restructuring Educational Pedagogy: Making Deep Changes in Traditional Delivery Methods

by Rob Reilly

"The education establishment, including most of its research community, remains committed to the educational philosophy of the late nineteenth and early twentieth century, and so far none of those who challenge these hallowed traditions has been able to loosen the hold the educational establishment has on how children are taught."

- Seymour Papert, *The Children's Machine*

Numerous research studies support the claim that affect plays a critical role in decision-making and performance as it influences the cognitive processes. Despite this body of research, there is insufficient theory within educational pedagogy to recognize and address the role and function of affect in facilitating the delivery of knowledge from a model-based domain. The innovative models and theories that have been proposed to facilitate advancement in the field of educational pedagogy tend to focus on cognitive factors: does the student under the knowledge that has been directed to them? how do we know that they understand what they have 'learner'? There is a need to frame a dialogue leading to new insights and innovations that incorporate theories of affect into educational pedagogy. We need to evolve new models that eliminate the theory under which a professor stands on a stage and lectures with the belief that students will *catch* the knowledge the professor is throwing-out and understand the underlying processes/model.

Education traditionally has emphasized conveying a lot of information and facts. When professors present material to the class, it is usually in a polished form that omits the natural steps of making mistakes (feeling confused), recovering from them (overcoming frustration), deconstructing what went wrong (not becoming dispirited), and starting over again (with hope and maybe even enthusiasm). The learning process naturally involves failure and a host of associated affective responses. However current educational pedagogy is lacking in certain areas and must be reengineered.

But reengineering educational pedagogy is a non-trivial task. To justify any change, it must be shown that past research or legacy research is obsolete or irrelevant. To make this point there is a need to briefly review the nature and purpose of education over the years.

In Colonial days, schools were based upon 'recitation literacy' and from the World War I era forward, schools were based upon *extraction literacy*. However, a major shift in intellectual abilities necessitated the requirement for students of the new millennium to understand the state of their knowledge, be able to build upon it, improve it, and apply it appropriately. In short we must envision graduates who can identify and solve problems, make contributions to society, and display qualities of 'adaptive expertise'. Thus contemporary thought views learning as a person's ability to construct new knowledge based upon what they already know or believe to be true in short, the ability to perform model-based reasoning, recursion, reflection, and meta-cognition.

Institutions of higher education are experiencing drastic changes in their challenges and expectations. Realizing that this educational shift is happening is critical when redesigning the delivery of knowledge from a model-based domain to a learner. These new goals require changes in the redesign of learning environments and learning theory. However, current learning theory does not provide a simple recipe for designing effective learning environments given these changes. "New developments in the science of learning raise important questions about the designs of learning environments…[the] general characteristics of learning environments…need to be examined in light of new developments in the science of learning". The basis of a model that will serve as a foundation for educational pedagogy should be embodied from such a mind-set (developing model-based thinkers). Educators should recognize the affective and cognitive state of the learner as the learner moves through their learning journey and be able to respond in an appropriate manner (*e.g.*, adjust the pace, direction, complexity).

The requisite for deep change in educational pedagogy would appear to involve:

- a novel model that supports model-based reasoning, and,
- an innovative learning cycle model that integrates/accounts for affect.

Announcements and News

African Engineering Education Professor Funso Falade (ffalade@hotmail.com) the president of the African Engineering Education Association (AEEA) is organizing the 5th African Regional Conference on Engineering Education (ARCEE 2010) in Libya between 2nd and 5th October, 2010. The Call For Papers will be available in the coming month and should be available via this publication. In the photo below: (left) is AEEA president Funso Falade, (right) is Professor Hamadou Saliah Hassane of TELEQ university in Montreal, Canada and a member of the Education Society's Administrative Committee.

FRONTIERS IN EDUCATION 2010

FIE 40 YEARS OF FIE 2010 WASHINGTON D.C.

ARLINGTON, VIRGINIA

http://fie-conference.org/fie2010/

October 27–30, 2010

IEEE EDUCATION SOCIETY ADMINISTRATIVE COMMITTEE MEETS AT ASEE CONFERENCE

ASEE Annual Conference
Louisville, Kentucky USA
Monday, 21 June 2010, 6:30pm to 8:30pm

International Conference ICL
Interactive Computer Aided Learning

13th ICL Conference - ICL2010
will be held from 15 - 17 September 2010
in Hasselt, Belgium.
http://www.icl-conference.org/

This interdisciplinary conference aims to focus on the exchange of relevant trends and research results as well as the presentation of practical experiences gained while developing and testing elements of interactive computer aided learning. Therefore pilot projects, applications and products will also be welcome.

Electrical and Computer Engineering Division of the ASEE

The annual ECE Division's business meeting will be held at the annual ASEE convention. This meeting is open to the public. Louisville, Kentucky USA on Monday, 21 June 2010, 7:00am to 8:30am.

The Interface

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For your information: The Interface is located at:

www.ewh.ieee.org/soc/es/interface.html

The deadlines for submission of materials for inclusion are:

- March 1 for the April issue,
- July 1 for the August issue, and,
- October 1 for the November issue.

Submitting an article for consideration

If you have an idea for a topic to be discussed in *The Interface*, submit a proposal to Rob Reilly (r.reilly@ieee.org). If you would like to have your position known on an issue relevant to engineers, then the article should range is from 250 words to 1,000 words. Generally speaking, 250 words does seem too brief to make-a-point and support an argument, and 1,000 may seem to be too many words for that purpose in this publication, but that may be what will suffice. We expect that the papers will be conversational rather than an empirical research paper. In short, the author(s) article should attempt to convenience the readership why they should be interested in a given topic/issue, or, why the readership should not be interested in a given topic/issue. I imagine *The Interface* will be a forum for scholarly commentary on all-sides of various issues that confront our profession on the academic side and the industry side.

Web Sites

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