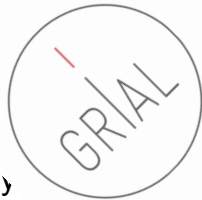


Mobile devices have a great penetration in education in general [12, 13] and in Engineering field specifically [14]. Three papers of this special issue address this topic from different perspectives. First, González-Rogado et al. paper “Mobile Technology in the Teaching Lab” applies mobile technology in the teaching lab with the threefold purpose of creating a safer environment for students, enhancing their culture of safety, and training professionals sensitized on safety, which eventually will allow them to make responsible decisions in their professional practice. Merayo et al. explain how to use the smartphones as learning platform to deliver learning packages throughout a multiplatform software application, called AIM-Mobile. Tuan Le et al., in their contribution entitled “A Framework for Using Mobile Based Virtual Reality and Augmented Reality for Experiential Construction Safety Education” use the mobile devices with safety purposes too. They propose the combination of virtual reality and augmented reality to promote safe and healthy work environment in the construction area.

Tuan Le’s paper might be classified into one of the topics of interest of this special issue, the advanced Human-Computer Interaction paradigms [15], which have an extended usage in the Engineering field. Four papers fall into this category: Learning Systems through Haptic Simulators – A Framework for Designing Haptic Simulators, by Esteban et al. proposes the modelling of an interactive learning environment using haptic virtual reality simulation for the training and learning of surgical procedures. Fonseca et al. “The Impact of Virtual Reality on the Learning of Engineering Students: Prepared for Academic Innovation?” present a mixed-method study that combines quantitative and qualitative techniques to evaluate the technological adoption and satisfaction of Multimedia and Augmented visualization methods. This study will show us the impact of these technologies when used in the classroom, but the process is hindered mainly by the lack of standard systems that allow the visualization and conversion of complex 3D models. The paper “User-centered Development of Generative Educational Systems for Computer Engineering: The *Evaluators* Case Study”, by Rodríguez-Cerezo et al., is devoted to describe *Evaluators*, an educational system oriented to the generation of different kinds of interactive simulations for introductory Compiler Construction courses in Computer Science and Computer Engineering degrees. Other interesting topic, very related to HCI issues, is the introduction of adaptive capabilities in the educational software or in the learning process [16, 17], a characteristic that has been explored several times regarding the programming skills [18] and in the assessment stage [19-20]. Precisely, Molins-Ruano et al. paper “An Adaptive Model for Computer-Assisted Assessment in Programming Skills” combines these two elements in order to propose a methodology aimed to improve the quality of the assessment process for subjects related to basic programming.



Gamification [21,22] and game-based learning [23] are other interesting topics with a growing presence in the innovative educational movement in Engineering specially oriented to achieve more engagement and motivation among the students [24]. Two papers about these themes are selected in this special issue. The first one, by Lasse Hakulinen, is entitled “Using Alternate Reality Games to Teach Computer Science Concepts – Case: Stop Toilworn Diamond”, is devoted to introduce an alternate reality game called Stop Toilworn Diamond in order to study the potential of using this kind of games in computer science education. The second one is entitled “Mecagenius®, an Innovative Learning Game for Mechanical Engineering”, by Galaup et al., and describes Mecagenius®, a learning game to teach mechanical engineering at an engineering faculty.

Other topic of interest is the usage of robots in the classroom as a didactical and innovative method [25]. The paper of Blanco et al. “Improving Robotics Teaching in the Computer Engineering Degree through the Action-Research Approach” may be classified under this descriptor and it describes an experience using Action-Research as the method to study the educational reality of robotics teaching in the Computer Engineering Degree, to improve its comprehension and to achieve its transformation in line with the European Higher Education Area (EHEA).

Perhaps the largest group of papers, with eight contributions in this collection, is regarding the development of transversal skills [26], competence assessment [27, 28], multicultural issues [29, 30] and informal learning activities [31, 32] in Engineering. De la Torre et al. in their paper “STELLA 3D: Introducing Art and Creativity in Engineering Graphics Education” defend that improvement of spatial skill is a basic competence to develop together with other general ones such as the decision making, teamwork, creativity and so on and they propose achieving this improvement throughout a workshop activity about creative three-dimensional modelling (Stella 3D). Martín-Gutiérrez et al. also consider the spatial skills as one of the most important for the professional development of an engineer. Their paper “Improving the Teaching-Learning Process of Graphic Engineering Students Through Strengthening of their Spatial Skills” presents the training activities based on virtual reality, augmented reality and PDF3D they have used for, and they make a comparison with the intention of finding which of them yields the best results as a training tool and improves the academic outcomes of the students in the subject of Engineering Graphics. In the paper “Monitoring Indicators for CTMTC: Comprehensive Training Model of the Teamwork Competence in Engineering Domain” Fidalgo-Blanco et al. apply a white-box testing method for the assessment of the learning of the teamwork competence. However these kinds of methods are effective, but not productive, thus they proposed improvements regarding the efficiency of these. López et al. in their paper entitled “Acquisition of Transferable Skills Associated with Software Maintenance and Development Using Tools for Versioning and Task Management” describe the usage of control version tools promoting and assessing the acquisition of certain generic skills related to the software

engineering topics. Balderas et al. paper “A Domain Specific Language for Online Learning Competence Assessments” introduces the Simple Assessment-Specific Query Language (SASQL) in order to help a course coordinator to extract different objective indicators to assess competencies defined in the syllabus using simple queries. Ćok et al. investigate in their paper “Multicultural Issues of Product Development Education in Virtual Teams” multicultural background of virtual team members from two different aspects: how it influences the team’s creativity and how various cultural backgrounds of creative team members could lead into different perceptions of particular design features. Informal learning recognition is the base for the papers of Casañ et al. and Conde et al.

The linked open data is an approach for interlinking data that allows digital resources to be shared, reused, and accessed [33-35]. Using linked open data, repository owners can publish structured data and establish categorized links between their repositories and from other sources. In the paper entitled “Interlinking Educational Data: an Experiment with Engineering-related Resources in GLOBE”, Rajabi et al. present a report primarily focused on evaluating the interlinking of engineering-related resources of a significant educational repository (GLOBE) to one of the most important datasets (DBpedia) on the Linked Open Data (LOD) cloud. After considering various interlinking approaches for link discovery, the paper focuses on the use of one of the interlinking tools (LIMES) and outlines the number of resources linked to the DBpedia dataset.

The final covered topic in this special issue is devoted to the MOOC phenomenon. MOOC are controversial, some love them and think this kind of massive and open education will revolutionize and transform the education reality, but others question the validity and quality of the MOOC model [36]. This special issue is not devoted to discuss about the present and future of MOOC, but it is true that MOOC are highly accepted by engineering students and by Engineering practitioners. In regard to this, Morales Chan et al. paper “MOOC Using Cloud-based Tools: a Study of Motivation and Learning Strategies in Latin America” describes the motivational and cognitive learning strategies used by students of the large-scale MOOC titled “Cloud-based Tools for Learning,” which consists of using free Web 2.0 tools for learning.

Finally, guest editors would like to thank Professor Ahmad Ibrahim, Editor in chief of International Journal of Engineering Education, for the opportunity to edit this special issue. In addition we are grateful to the pool of reviewers who generously devoted time to provide feedback to the authors.

References

- [1] F. J. García-Peñalvo, A. Sarasa Cabezuelo and J. L. Sierra González, Innovating in the Engineering Processes: Engineering as a Means of

- Innovation, *IEEE Revista Iberoamericana de Tecnologías del Aprendizaje (IEEE RITA)*, **9**(4), 2014, pp. 131–132, doi: 10.1109/RITA.2014.2363004.
- [2] R. Bolstad, J. Gilbert, S. McDowall, A. Bull, S. Boyd and R. Hipkins, *Supporting future-oriented learning & teaching — A New Zealand perspective. Report to the Ministry of Education*, Ministry of Education, New Zealand, 2012.
- [3] B. Frame and J. Brown, Developing post-normal technologies for sustainability. *Ecological Economics*, **65**(2), 2008, pp. 225–241.
- [4] J. Dyer, H. Gregersen and C. M. Christensen, *The Innovator's DNA: Mastering the Five Skills of Disruptive Innovators*, Harvard Business Review Press, Boston, Massachusetts, USA, 2011.
- [5] IBM, Capitalizing on complexity. Insights from the Global Chief Executive Officer Study, IBM, 2010.
- [6] F. J. García-Peñalvo, R. Colomo-Palacios and M. D. Lytras, Informal learning in work environments: training with the Social Web in the workplace, *Behaviour & Information Technology*, **31**(8), 2012, pp. 753-755, doi: 10.1080/0144929x.2012.661548.
- [7] F. J. García-Peñalvo, M. Johnson, G. Ribeiro Alves, M. Minovic and M. Á. Conde-González, Informal learning recognition through a cloud ecosystem, *Future Generation Computer Systems*, **32**, 2014, pp. 282-294, doi: <http://dx.doi.org/10.1016/j.future.2013.08.004>.
- [8] R. Colomo-Palacios, C. Casado-Lumbreras, P. Soto-Acosta and S. Misra, Providing knowledge recommendations: an approach for informal electronic mentoring, *Interactive Learning Environments*, **22**(2), 2014, pp. 221-240, doi: <http://dx.doi.org/10.1080/10494820.2012.745430>
- [9] Australian National Audit Office, *Innovation in the public sector: Enabling better performance, driving new directions*, Australian National Audit Office, Canberra, Commonwealth of Australia, 2009.
- [10] Department of Education and Child Development. *Research and Innovation Framework*, 2010. Available: http://www.decd.sa.gov.au/research/files/links/Research_Framework_DEC_D_F_1.pdf.
- [11] M. L. Sein-Echaluce Lacleta, Á. Fidalgo Blanco and F. J. García-Peñalvo, Buenas prácticas de Innovación Educativa: Artículos seleccionados del II Congreso Internacional sobre Aprendizaje, Innovación y Competitividad, CINAIC 2013, *RED. Revista de Educación a Distancia*, **44**, 2014.
- [12] J. C. Sánchez Prieto, S. Olmos Migueláñez and F. J. García-Peñalvo, Understanding mobile learning: devices, pedagogical implications and research lines, *Revista Teoría de la Educación: Educación y Cultura en la Sociedad de la Información*, **15**(1), 2014, pp. 20-42.
- [13] J. C. Sánchez Prieto, S. Olmos Migueláñez and F. J. García-Peñalvo, ICTs Integration in Education: Mobile Learning and the Technology Acceptance Model (TAM), in F. J. García-Peñalvo (ed), *Proceedings of the Second International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'14)*, Salamanca, Spain, October 1-3, 2014, ACM, New York, USA, 2014, pp. 683-687.

- [14] M. Á. Conde, F. J. García-Peñalvo, M. Alier, M. J. Casany and J. Piguillem, Mobile devices applied to Computer Science subjects to consume institutional functionalities through a Personal Learning Environment, *International Journal of Engineering Education (IJEE)*, **29**(3), 2013, pp. 610-619.
- [15] F. J. García-Peñalvo and J. Abascal, Human-Computer Interaction Research and Development Challenges, *Journal of Universal Computer Science*, **14**(16), 2008, pp. 2597-2598.
- [16] A. J. Berlanga and F. J. García-Peñalvo, IMS LD reusable elements for adaptive learning designs, *Journal of Interactive Media in Education*, **11**, 2005.
- [17] A. J. Berlanga and F. J. García-Peñalvo, Learning Design in Adaptive Educational Hypermedia Systems, *Journal of Universal Computer Science*, **14**(22), 2008, pp. 3627-3647, doi: 10.3217/jucs-014-22-3627.
- [18] M. Bielikova, An adaptive web-based system for learning programming, *International Journal of Continuing Engineering Education and Life Long Learning*, **16**, 2006, pp. 122-136.
- [19] H. Barbosa and F. J. García-Peñalvo, Importance of Online Assessment in the E-Learning Process, *Proceedings of the 6th International Conference on Information Technology Based Higher Education and Training - ITHET 2005*, Santo Domingo, Dominican Republic, July 7-9, 2005, IEEE CS-Press, USA, 2005, pp. F3B-1-F3B-6.
- [20] Y. He, S. C. Hui, and T. T. Quan, Automatic summary assessment for intelligent tutoring systems, *Computers & Education*, **53**(3), 2009, pp. 890-899.
- [21] K. M. Kapp, *The Gamification of Learning and Instruction: Game-based Methods and Strategies for Training and Education*, Wiley, San Francisco, CA, USA, 2012.
- [22] E. Herranz Sánchez, R. Colomo-Palacios, A. de Amescua-Seco and M. Yilmaz, Gamification as a disruptive factor in software process improvement initiatives. *Journal of Universal Computer Science*, **20**(6), 2014, pp. 885-906.
- [23] T. M. Connolly, M. Stansfield and T. Hainey, An application of games-based learning within software engineering, *British Journal of Educational Technology*, **38**(3), 2007, pp. 416-428.
- [24] P. Molins-Ruano, C. Sevilla, S. Santini, P. A. Haya, P. Rodríguez and G. M. Sacha, Designing videogames to improve students' motivation, *Computers in Human Behavior*, **31**, 2014, pp. 571-579, 2014, doi: 10.1016/j.chb.2013.06.013.
- [25] B. Curto and V. Moreno, A robot in the classroom, in F. J. García-Peñalvo (ed), *First International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'13)*, Salamanca, Spain, November 14-15, 2013, ACM, New York, USA, 2013, pp. 295-296.
- [26] L. Vicent, X. Avila, J. Riera, D. Badia, J. Anguera and J. A. Montero, Appropriateness of e-learning resources for the development of transversal skills in the new European Higher Education Area,

- Proceedings of 36th Annual Frontiers in Education Conference*, San Diego, CA, October 27-31, 2006, IEEE, USA, 2006, pp. 6-11, doi: 10.1109/FIE.2006.322671.
- [27] A. Wolf, *Competence-based Assessment*, Open University Press, Philadelphia, PA, USA, 1995.
- [28] R. Colomo-Palacios, C. Casado-Lumbreras, P. Soto-Acosta, F.J. García-Peñalvo, and E. Tovar-Caro, Competence gaps in software personnel. A multi-organizational study, *Computers in Human Behavior*, **29**(2), 2013, pp. 456-461, doi: <http://dx.doi.org/10.1016/j.chb.2012.04.021>
- [29] F. J. García-Peñalvo, *Multiculturalism in Technology-Based Education. Case Studies on ICT-Supported Approaches*, Information Science Reference, Hershey, PA, USA, 2013.
- [30] C. Casado-Lumbreras, R. Colomo-Palacios, P. Soto-Acosta and S. Misra, Culture dimensions in software development industry: The effects of mentoring, *Scientific Research and Essays*, **6**(11), 2011, pp. 2403-2412.
- [31] F. J. García-Peñalvo, M. Á. Conde, V. Zangrando, A. García-Holgado, A. M. Seoane, M. A. Forment, *et al.*, TRAILER project (Tagging, recognition, acknowledgment of informal learning experiences). A Methodology to make visible learners' informal learning activities to the institutions, *Journal of Universal Computer Science*, **19**(11), 2013, pp. 1661, doi: 10.3217/jucs-019-11-1661.
- [32] C. Viegas, M. Marques, G. Alves, A. Mykowska, N. Galanis, M. Alier, *et al.*, TRAILER – a Tool for Managing Informal Learning, *International Journal of Human Capital and Information Technology Professionals (IJHCITP)*, **5**(3), 2014, pp. 1-17, doi: 10.4018/ijhcitp.2014070101.
- [33] T. Heath and C. Bizer, Linked Data: Evolving the Web into a Global Data Space, *Synthesis Lectures on the Semantic Web: Theory and Technology*, **1**(1), 2011, pp. 1-136, doi: 10.2200/S00334ED1V01Y201102WBE001.
- [34] N. Piedra, E. Tovar-Caro, R. Colomo-Palacios, J. López, and J. Chicaiza, Consuming and producing linked open data: the case of OpenCourseware, *Program: electronic library and information systems*, **48**(1), 2014, pp. 16-40, doi: <http://dx.doi.org/10.1108/PROG-07-2012-0045>
- [35] R. Colomo-Palacios, V. Stantchev and A. Rodríguez-González, Special issue on exploiting semantic technologies with particularization on linked data over grid and cloud architectures, *Future Generation Computer Systems*, **32**, 2014, pp. 260-262, doi: <http://dx.doi.org/10.1016/j.future.2013.10.021>
- [36] Á. Fidalgo Blanco, M. L. Sein-Echaluce Lacleta and F. J. García-Peñalvo, Methodological Approach and Technological Framework to break the current limitations of MOOC model, *Journal of Universal Computer Science*, **In Press**, 2015.

Biographies

Francisco-José García-Peñalvo got his BS. and MS. Degrees on Software Engineering by the University of Salamanca and University of Valladolid and a CS PhD by the University of Salamanca. Dr. García-Peñalvo is the GRIAL (research GRoup in InterAction and e-Learning) head. His main research interests are eLearning, Computers & Education, Adaptive Systems, Web Engineering, Semantic Web, and Software Reuse. He has led and participated in more than fifty research and innovation projects. He was Vice-Rector for Technology Innovation at the University of Salamanca from March 2007 to December 2009. He has more than 100 published papers in international journals and conferences. He has been guest editor of several special issues in top international journals (Online Information Review, Computers in Human Behavior, Interactive Learning Environments, International Journal of Engineering Education...). In addition, he is a PC member in several international conferences and a reviewer of several international journals and the Editor-in-Chief of Education in the Knowledge Society Journal and the Journal of Information Technology Research. He is the coordinator of the Education in the Knowledge Society PhD Program at the University of Salamanca.

Ricardo Colomo-Palacios, Full Professor at the Computer Science Department of the Østfold University College, Norway. Formerly he worked at Universidad Carlos III de Madrid, Spain. His research interests include applied research in information systems, software project management, people in software projects, business software, software and services process improvement and web science. He received his PhD in Computer Science from the Universidad Politécnica of Madrid (2005). He also holds a MBA from the Instituto de Empresa (2002). He has been working as Software Engineer, Project Manager and Software Engineering Consultant in several companies including Spanish IT leader INDRA. He is also an Editorial Board Member and Associate Editor for several international journals and conferences and Editor in Chief of International Journal of Human Capital and Information Technology Professionals.