**Guest Editorial:**

**Special Issue on Emerging Trends in Education – Part I**

Beyond their administrative functions, computer use in education has traditionally been limited to training students on the usage of related technologies or for the delivery of standard teaching materials and content. With the advent of social media, pervasive and mobile computing, and with the vast amount of data that those systems generate and collect, this situation is changing.

Computers can make learning more interesting, by allowing teaching content and methods to be enriched with many different perceptual stimuli and by simplifying the presentation of ideas. Moreover, computers have enabled the creation of educational environments with little constraints on space and time, with teachers and students able to work over great distances in both synchronous and asynchronous ways and with access to increasingly large repositories of dynamic learning content.

While the aforementioned scenario is becoming commonplace, the educational paradigm is still largely unchanged – only the shackles of physical proximity are broken. Greater opportunities for educational evolution abound with the latest in computing advances.

For instance, distributed learning systems start benefiting from such technologies as cloud and mobile computing by further extending their reach and becoming ever more ubiquitous in the lives of students and teachers. The recent Open Data and Linked Data initiatives, together with the latest Web technologies, are easing the creation of ever wider repositories of learning materials, by integrating heterogeneous information expressed in different languages, formats, etc. Data and learning analytics technologies, combined with a number of methods for intelligent computing, are helping to grasp the incredible volume of information produced by the above systems and to develop software tools able to automatically adapt teaching and learning to users’ needs. Evolving computer graphics technologies combined with new natural interaction methods and devices based on speech, gesture, gaze, and haptic control and feedback, are changing the way learning tools and applications are operated, thus making them ever more accessible, intuitive, and effective. The widespread diffusion of sensing technologies may allow education and training systems to become ever more aware of the surrounding environment and dynamically adapt to a changing context. Great changes are also occurring in terms of approaches to education, with computing technologies blending with those for gaming and entertainment and encountering the “how to do” philosophy, thus becoming the element learning is built around. Computers are also accompanying education outside formal learning environments, becoming the enabling technology behind the construction of non-formal and informal education and training systems and also acting as a bridge between the education domain and the labor world.

Despite the great opportunities that may be envisioned for computing technologies in the above scenario, there is not a consensus yet on the effects that the above trends might have on the education of tomorrow.

With its 16 papers selected among 79 submissions after an intense review process, this special issue on “Emerging Trends in Education” aims to present best practices that pertain to different areas of interest for the various actors of the education domain, with the goal to provide a comprehensive picture of experiences that are being carried out in different contexts and to become a reference for activities that will be developed in the coming years. This part includes the first eight papers of the special issue, which have been selected among accepted submissions based on a pure chronological criterion.

In “Using Google tools for online coursework: Student perceptions”, Rachel S. Harris and Charles B. Hodges report upon that, despite the wide set of functionalities offered by today’s Learning Management Systems (LMSs), access to the latest features required, for example, to support peer collaboration and active participation, often comes at licensing costs well beyond the means of small-scale educational settings. Hence, they developed an online course based solely on tools freely available on the Google platform. They then analyzed students’ perceptions and reactions and compared them to previous experiences using the LMS implemented at their institution.

In the paper titled “Understanding CMOS technology through TAMTAMS Web” by Fabrizio Riente et al., the evolution of a tool supporting the study of the scaling in transistor technology from a standalone computer program to a Web application is reported. In particular, the tool allows the students to analyze the main characteristics of a CMOS transistor at device, gate and system level, by letting them evaluate
how parameters like current, threshold voltage, mobility, etc. impact circuit performance. The proposed tool is based on an open structure, in contrast to competing solutions, which is expected to be capable of easing the future integration of new emerging models and technologies.

In “Gradually learning programming supported by a growable programming language”, Walter Cazzola and Diego Mathias Olivares keep the focus on learning tools capable of supporting teachers and students in their common activities. They posit that teaching and learning programming is over-complicated by the complexities of the programming languages used. A programming language makes use of a number of constructs with increasing complexity that are strictly interconnected, but are generally explained at different times. Unfortunately, even very basic programs need such constructs and teachers usually skip related concepts, assuring the student that an explanation will follow. This approach creates a sense of incompleteness and disorientation, which may hinder proper understanding. Based on the above considerations, the authors present a methodology to gradually teach programming by means of a language that grows along with the number of concepts presented to the students. The authors experimented with the teaching of JavaScript, though the proposed approach is general and could be applied in principle to any programming language.

Another work aimed to investigate how novel technology can help to improve learning effectiveness by especially focusing on the students perspective is reported in the paper by Elena Baralis and Luca Cagliero titled “Learning from summaries: Supporting e-learning activities by means of document summarization”. This paper, like the previous one, is an extended version of a conference paper presented at the Symposium on Computing Education & Learning Technologies (CELT) of COMPSAC 2016. First, the authors present the results of a user study based on crowdsourcing aimed to assess to what extent the use of a state-of-the-art summarization system can support individual and collective learning in a traditional learning context by matching students’ expectations. Then, they experiment with a modified version of the summarization system designed to take into account document highlights, annotations and users’ skills. Lastly, they explore the possibility of generating multiple summaries of the same document tailored to users with different skill levels, confirming that the proposed tool could be exploited in heterogeneous learning scenarios.

Given the increasing role that game-based learning is expected to play in the coming years, the paper titled “Can gamification improve the benefits of student response systems in learning? An experimental study” by César Morillas Barrio et al. focuses on the introduction of game dynamics in education. Specifically, the authors present the design and evaluation of a tool where the benefits of Student Response Systems (SRSs) are combined with those associated with the use of gamification techniques to improve students’ engagement and learning results. SRSs are well known since from the 1970’s, when so-called “clickers” were exploited to let instructors get a real time feedback from the students during lectures, which can be used, e.g., to tailor contents to audience’s needs and expectations. Although, as shown in a number of application fields, technological developments contributed to make SRSs ever more powerful, their effectiveness is still largely related to the strategy adopted for asking questions. Through a user study, the authors demonstrate that, by structuring questions-answering as a class game with students organized in groups submitting responses using a smartphone and checking class results on a public score board, students’ perception in terms of motivation, attention and learning performance can be expected to be higher than in a non-gamified SRS-based scenario.

In the paper titled “Digital manipulative as scaffolds for pre-schoolers’ language development” by Cristina Sylla et al., an analysis of the opportunities offered by tangible user interfaces for the design of learning scenarios promoting a playful experience in pre-school contexts is reported. In particular, the authors discuss the design of a digital manipulative based on physical instrumented blocks representing sceneries, objects and characters, which can be arranged on an electric platform to let the users tell a story. The sequence of blocks used unfolds a visual narrative, which is recreated on screen using 2D graphics. The devised system was tested with five years-old students with the pedagogical goal to enhance their lexical knowledge and language awareness.

Open student model (OSM)-based techniques are also well represented in this special issue, confirming the great interest expressed by the research community and education stakeholders on this topic. In this first part, the paper titled “Open social student modeling for personalized learning” by Peter Brusilovsky et al., presents and extension of open student modeling that aims to enhance cognitive aspects of OSM techniques with social aspects thus letting students explore and compare models of their peers or of the whole class. In particular, the authors hypothesize that students’ individual characteristics may significantly influence the perception of results obtained through such an emerging approach. Hence, they present the results of a comprehensive classroom study, where open social student modeling (OSSM) with social visualization features is compared to OSM in the context of an open source adaptive learning portal designed to support lifelong learning through intelligent recommendation of online resources. The study showed an interesting engagement power of OSSM compared to OSM, and confirmed the ability of social visualization tools to improve students’ work efficiency and learning effectiveness.

Lastly, the paper titled “An ontology-based approach for the semantic representation of job knowledge” by Marjan Khobreh et al. tackles an issue that is becoming ever more important in the education domain, and concerns the link between learning outcomes associated, on the one side, to a given qualification and, on the other side, requested in order to apply for a given job position. In this paper, the focus is specifically on vocational education and training (VET),
and an ontology is defined for bridging job and knowledge elements collected from various sources and support the identification of possible knowledge shortages as well as the determination of mismatches between job tasks and knowledge domains.

The papers presented in the first part of this special issue demonstrate how rich and diverse are the research activities at the intersection between education and emerging technologies. We wish to thank both the authors and the reviewers for their great contribution to this special issue. We are grateful to the Editor-in-Chief, Prof. Fabrizio Lombardi for providing us with this opportunity and for the precious guidance and support offered throughout the whole process.

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