Motivating students with Mobiles, Ubiquitous applications and the Internet of Things for STEM (MUMI4STEM)

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I. INTRODUCTION

The special track "Motivating students with Mobiles, Ubiquitous applications and the Internet of Things for STEM (MUMI4STEM)", within the "EDUCON2017 IEEE Global Engineering Education Conference", integrates two main areas of interest in STEM education: 1) motivating students with mobile devices and 2) exploiting ubiquitous computing and the Internet of Things. Following the growing interest of the educational and research community towards fostering STEM education, this special session aims at promoting the discussion about the motivational aspects of mobile learning and the benefits of ubiquitous applications and the Internet of Things (IoT), with special focus on supporting STEM education.

II. BACKGROUND

A. Mobile Learning

Mobile learning, offers learners the potential to acquire knowledge and skills in a ubiquitous and personalized manner, facilitating a learner-centered learning experience in "anytime and anywhere" settings. Among the numerous elements that are associated with a successful mobile learning strategy, emotional, affective and motivational factors are considered especially important and need to be further investigated.

B. Ubiquitous computing

Ubiquitous computing is crucial in environments in which computing is seamlessly integrated and embedded in the background. Teachers can exploit it in education coupled with innovative pedagogies, like constructionism and 'learning-by-doing', in order to augment the learning experience and showcase how programmable, mobile and personal devices can impact people's lives.

C. Internet of Things

Internet of Things (IoT) is a relatively new technology that leverages the ubiquity of the Internet by integrating physical objects for interaction via embedded systems [5]. This type of interactions lead to a highly distributed network of devices communicating with humans and other devices [5].

D. STEM

STEM (Science, Technology, Engineering, and Mathematics) education is currently one of the main priorities in many educational systems worldwide. Despite the fact that employment opportunities in STEM professions are growing, the number of students interested in pursuing science careers is on a descendent trend. How can Ubiquitous computing, Mobile Computing and the Internet of Things (UMI) be used in order to motivate students towards STEM education?

III. MOTIVATING STUDENTS WITH UMI FOR STEM

Six studies are part of this special track covering a range of aspects of the topic at stake. They are described in brief below.

A. Mobile-Based Assessment Motivational Framework

The study by Nikou and Economides [1] proposes a Mobile-Based Assessment Motivational Framework (MBAMF) based on the Self-Determination Theory of Motivation. Mobile-Based Assessment (MBA) is a contemporary assessment practice that uses mobile devices inside or outside the classroom boundaries. The affordances offered by mobile devices, e.g. personalization, ubiquity, context-awareness, interactivity, multiple media representation and social-media connectivity can enrich and transform assessment practices. According to previous research, the affordances offered by mobile devices, when used in assessments, have a positive impact on students' motivation and intention to use [2]. The proposed MBAMF investigates the links between the MBA affordances and the fundamental constructs of the Self-Determination Theory of Motivation. A preliminary evaluation of the model, with medical students in a near-patients clinical training environment showed that MBAMF can effectively support perceived autonomy, competence and relatedness.

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B. Mobile Augmented Reality Plant Inquiry Learning System

The study by Ahmed et al. [3] presents a Mobile Augmented Reality Plant Inquiry Learning System (MAPILS) to conduct plant Inquiry-Based Learning (IBL) activities using Augmented Reality (AR) technology. In the context of science education, mobile-assisted IBL has a positive on learning attitudes and performance. Furthermore, mobile-based AR is a relatively new trend in education with a promising potential in IBL. The proposed system helps students to learn about plants. The system is evaluated in terms of technological usability and learners' perceptions using the Mobile Science Inquiry (MSI) evaluation framework [4]. Evaluation of the potential benefits of such technology in science education showed that the designed mobile system possesses motivating and enjoyable learning experience for science students.

C. Communities of computing education in Norway

The paper [6] seeks to examine how existing communities in computing education thrive in Norway and manage to empower school pupils and tutors realising their role in the digital society, learn programming, and become familiar with Computer Science and Information Technology. Two semi-structured interviews were conducted with organisers and designers of activities that promote computing education and programming in Norway. Also, one focus group discussion was conducted with high school students that participated in a small number of learning activities on design thinking, programming and Internet of Things. The results were qualitatively analysed in order to conclude how different aspects (cognitive, social, etc) are manifested and interweaved in these communities.

D. Reviewing literature on Tangible Programming Languages

During the last few years, the development of tools for learning programming in primary and secondary schools (shortly K-12) has reached a significant turning point. This study [7] reviews published papers on the field of Tangible Programming Languages (TPLs) in K-12 schools in order to summarize the findings, guide future studies and give reflections for design and practice. From a systematic literature search, twelve TPL peer reviewed articles were collected and analyzed. Results of this short survey show that designers should emphasize on TPLs unambiguous manipulations, and consider clear mappings between tangible and virtual commands. Despite the challenges, the studies reviewed suggest that implementing programming lessons in K-12 education using TPL could be an enjoyable and effective learning experience.

E. Instructional Design for a U-Learning Ecology

There are various research challenges regarding the design and use of instructional design tools in complex learning contexts such as as UMI technologies. The paper by Fragkou, Kameas and Zaharakis [8] presents the rationale, important issues and methodology constructed in the context of UbiComp to define an instructional design process for building a U – Learning Ecology for multidisciplinary education. The authors provide a consistent framework and structural view of integrating instructional design principles in UbiComp learning. They discuss their ideas on the design of a U-learning ecology by the gradual building of a robust design process and they provide an overview of their ongoing work on design/analysis tools supporting early stage prototyping for using UMI technologies.

F. Comparison of Secondary Computer Science Curricula

UMI affects the way we live and learn. Ongoing research efforts aim at providing an educational framework that would exploit these technologies in order to support and enhance STEM education. The foundations for the development of the framework are laid by a comparison of secondary Computer Science education curricula in Greece, Cyprus and England. The research presented in [9] discusses the relation of the computing knowledge, understanding and skills acquired by students in different countries.

IV. CONCLUSIONS

All six studies aim at investigating the impact of UMI on education. Consequently, they can be of interest to researchers, educators, curriculum designers, educational technologists and educational policymakers. In particular, the special track contributes to STEM education research by providing insights and highlighting future directions on a number of interesting aspects: innovative pedagogical methods (including assessment) and tools, community aspects, curriculum design aspects and instructional design aspects that take into account the affordances of UMI in order to enhance STEM education.

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