A psycho-social perspective on STEM education in Italian high-schools: the "UMI-Sci-Ed" Project.*

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"Exploiting Ubiquitous Computing, Mobile Computing and the Internet of Things to promote Science Education" - "UMI-Sci- Ed".

What is UMI-Sci-Ed?

EXPLOITING UBIQUITOUS COMPUTING, MOBILE COMPUTING AND THE INTERNET OF THINGS TO PROMOTE SCIENCE EDUCATION (UMI-SCI-ED) is a Horizon 2020 project, which aims at enhancing the attractiveness of science education and careers for young people **(14-16 year olds)** in European countries, via the use of latest technologies and under the objectives of the work programme **"Innovative ways to make science education and scientific careers attractive to young people".**

Objectives

UMI-Sci-Ed aims to put **Ubiquitous and Mobile Computing and the Internet of Things (UMI)** into practice towards enhancing the level of **STEM education** and increasing the attractiveness of pursuing a career in domains pervaded by UMI for these youths.

Further description and purposes of the project are available on the website

http://umi-sci-ed.eu/

"The orientation of UMI-Sci-Ed is entrepreneurial and multidisciplinary in an effort to raise young boys' and girls' motivation in science education"

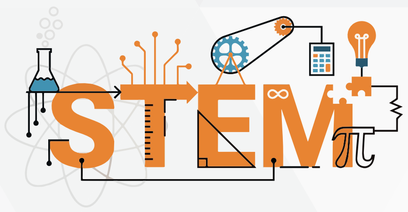
Partners

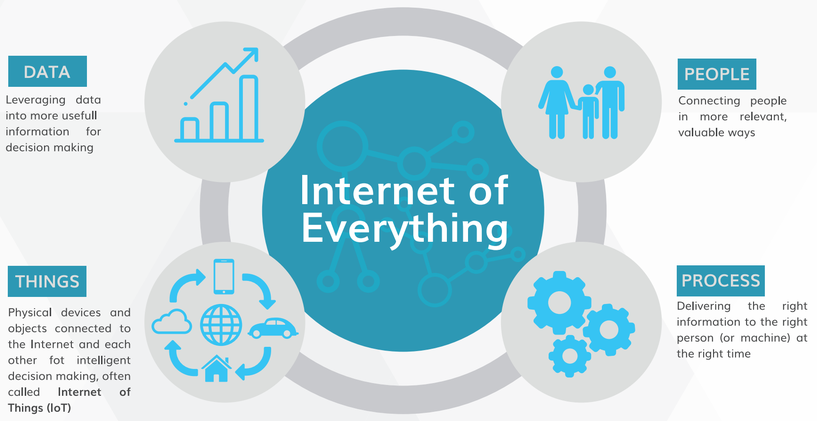
Actors | Participants

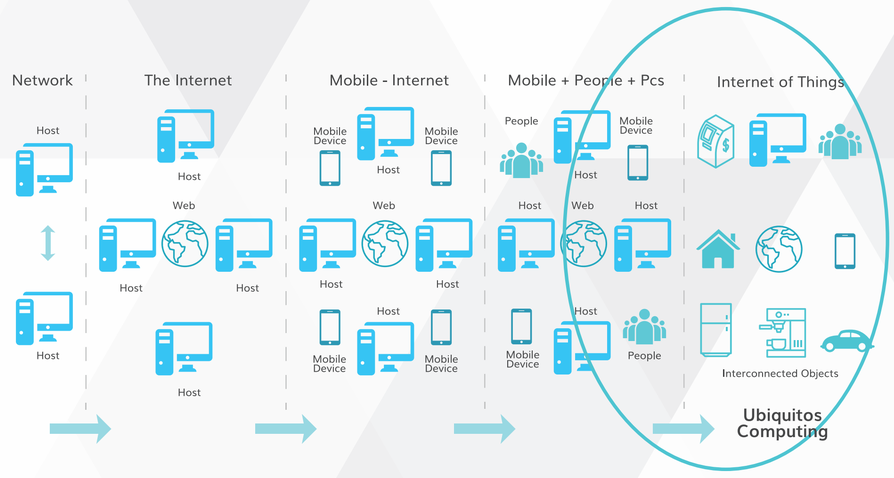
Researchers | Students | Teachers | Corporate

Key Constructs

STEM = Science, Technology, Engineering and Mathematics | **UMI** = Ubiquitous Computing + Mobile Internet + Internet of Things | **CoP** = Community of Practice







Methodology

The UMI-Sci-Ed project promotes an innovative psycho-social and pedagogical approach in a **social-constructionist** perspective highlighting the construct of **Community of Practices** (CoP; Wenger, 1998).

Social-constructionism applied to science education (e.g. Fensham et al., 2013) frames knowledge as **constructed** through interactions and communications between people. *"The best way to construct knowledge or understanding is through the construction of something shareable, outside of a student's head"* (Martinez & Stager, 2013, p. 59).

Communities of practice (CoPs) are the main construct in the **social theory of learning** proposed by **Wenger (1998)** in which learning was defined as social and situated, also as participation in the social world (see also Lave & Wenger, 1991). **CoPs** are formed by **people who engage in a process of collective learning in a shared domain** (Wenger, 1998).

"CoPs are groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (Wenger et al., 2002, p.4).

CoPs perspective and its methodologies are in line with research on **innovative learning approaches** enhancing creativity, socialization, and "scientific citizenship" (e.g. Marks, 2013) of students and teachers.

In this vein, all participants at the UMI-Sci-Ed CoP, i.e., the project partner, students, teachers, corporate and the actors involved, collaboratively interact by mean of an **open-source web-based platform** that supports the formation and management of CoPs (including social computing tools and synchronous/asynchronous communication tools), available at **http://umi-sci-ed.eu/the-platform/**

Pilot Study Phase

The psycho-social and pedagogical approach endorsed through the Umi-Sci-Ed project has been investigated through a "piloting phase" involving students and their teachers from the five countries partners (i.e. Italy, Norway, Finland, Greece, and Ireland).

In the Italian context, a *pilot study* has been conducted involving students from "*Computer science*" and "*Telecommunications*" articulations of the "*Computer science and telecommunications*" curriculum of the I.I.S. "L. da Vinci-Fascetti" (Pisa)

The participants have been involved in a workshop (plenary session) through which they were introduced by the UNIPI team on the topics of "The evolution of Telecommunications and the Internet of the Future" focusing on the use of IoT technologies (e.g. the 6LoWPAN technologies, wireless sensor network for 4.0 industry and Cyber-physical system), STEM and innovative use of technology for increasing learning, skills, and knowledge, and related issues on competitiveness, the UDOO board and the "Machine Learning for the data".

The students concretely managed—in an active and collaborative way, working as a CoP— the UDOO board as a Gateway, Openmote and Cloud integration (WATSON * IBM BLUEMIX), measuring the level of illumination in the environment and following all the phases to transfer these values to an IoT cloud.

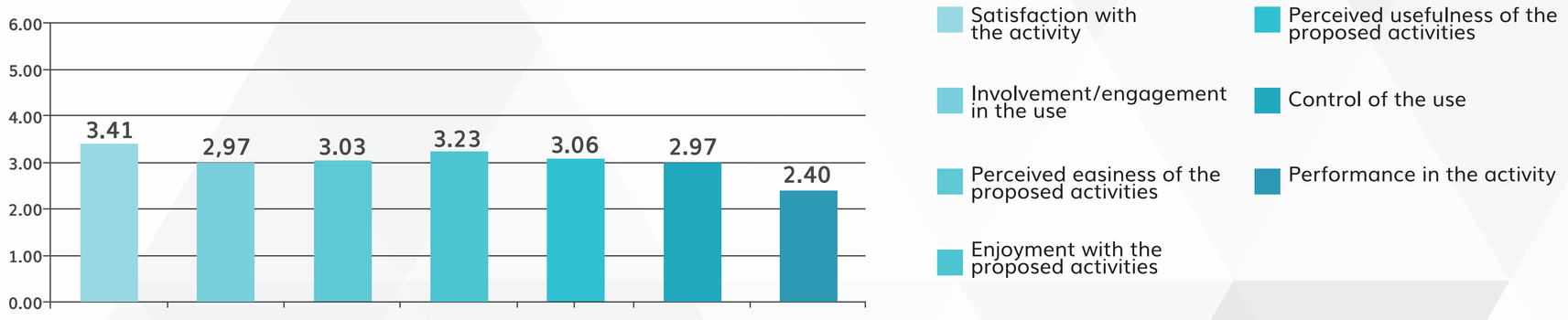
Afterward a total of 29 students (93% were male; M*age* = 18; SD*age* = 1.0) filled a self-report questionnaire measuring their satisfaction and **general attitudes toward the activities** carried out.

The questionnaire included closed questions (on a Likert scale ranging from "0 = Not at all" to "6 = Very much") and two open-ended question in which the participants were asked to leave comments on their feeling and proposal on the activities. Participants could also leave free comments (qualitative were analyzed according to Discourse Analysis technique; see van Dijk, 1993).

Main results

Main results of the Italian Pilot Study are presented in Figure 1. As shown, the participants reported themselves as moderately satisfied with the activities carried out. Results also showed medium levels of all attitudes toward the activities and the new technologies experimented. The qualitative data gathered and analyzed generally corroborated these findings

Figure 1. Main result from the Italian Pilot Study



Next steps and advances

These first results provide a basis for larger-scale pilot studies that will be conducted in each of the five countries partners during the scholastic year 2018-2019. The main goal of large-scale studies is to promote innovative methods to improve the skills, knowledge and expertise of young people towards UMI technologies in STEM education (proposal UMI-Sci-Ed).

Additionally, during the large-scale studies, some individual **factors**, e.g., Affinity For Technology (Edison & Geissler, 2003) and Need for cognitive closure (Pierro & Kruglanski, 2005), will be measured in the students in order to understand if they **influence**, in varying degrees, students' **learning experiences**. The study of these effects can be productive in order to improve the effectiveness of the proposed methods, as well as increase our theoretical knowledge.

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