PREFACE

Emerging Design: Transforming the STEAM Learning Landscape with the Support of Digital Technologies

More than 25 years ago, it was argued that in the coming decades, the use of Information and Communication Technologies (ICT) in education would likely be less of a consequence of technological **impediments** rather than a result of **limited** human imagination combined with the constraints of old habits and social structures [1] For instance, during the last few years, the trend to introduce approaches such as computational thinking at different levels and subjects in the school classroom has stimulated teachers to create and develop innovative teaching and learning activities. Consequently, these efforts are starting to shape new teaching and educational practices that take advantage of some of the features that smartphones, tablets, microcontrollers kits and 3D printers offer to enhance teaching and learning. However, a number of pedagogical challenges still remain related to the design of everyday educational practices that embrace the use of new ICT technologies and tools in heterogeneous learning landscapes. Increased interest in challenge-based learning and open-ended activities with a focus on Science, Technology, Art, Math and Engineering (STEAM) is transforming education by providing new opportunities for integrating ICT across a wide variety of subjects.

STEAM offers possibilities for activities that engage students in design and engineering tasks to explore science and math through creativity, expressiveness and visual aspects that also support logical and mathematical thinking. Creativity in STEM subjects can be understood as "generating ideas and strategies as an individual or community, reasoning critically between these and producing plausible explanations and strategies consistent with the available evidence" [2]. Modern ICT tools and systems provide platforms for new explorations and support for these activities and novel approaches. Moreover, these processes can metaphorically be seen as a complex ecosystem on the verge of multiple transformations.

This special issue brings together five compelling articles that investigate how distinct aspects of STEAM have acted as a catalyst for the transformation of teaching and learning practices. The first two the papers look at the transformation that takes place in universities with relation to how physical spaces and tangible activities can provide new opportunities to support creativity. The third article focuses on how tablet computers contribute to more dynamic teaching and learning environments that enhance design education. The fourth paper illustrates how ICT crosses the traditional subject of history with "maker" technologies that engage students with learning activities that transform history and robotics. The fifth paper expands the transformation to pragmatic requirements of how digital technologies require teachers to expand their roles and perceptions to support the challenges related to sustainability.

In *"A novel educational model based on 'knowing how to do' paradigm implemented in an academic makerspace"*, Carulli, Bordegoni, Maffei, Bianchini, & Bolzan present how the traditional classroom is exchanged and transformed into learning makerspaces. In these new learning spaces students design, experiment and

learn about STEAM related topics collaboratively. The authors conclude that such an approach results in the development of the learners' ability to solve problems using innovation, entrepreneurial and heuristic skills.

Creative competence is becoming more and more critical in engineering education. In *"Tangible 3D Printed Workshop for introducing Art and Creativity in Engineering Drawing Subject"*, Melian, Saorin, de La Torre-Cantero, & Diaz explore how three-dimensional modelling transforms graphic drawing in engineering. The authors demonstrate that students experiencing 3D-modelling significantly increase their creative skills that can enhance their engagement in engineering drawing.

More and more research results are showing that tablets introduce transformations in learning and teaching practices. In *"Using Tablets to Enhance the Teaching and Learning Environment in Landscape Architecture: A Pilot Study"*, Griesel & Price demonstrate that the use of tablets may transform architectural design education in terms of redefined learning spaces, enhanced learning environments and shifted learner and teacher roles.

The last two papers deal with changes related to the transformations in computing education.

The paper *"STEAMing the Ships for the Great Voyage: Design and Evaluation of a Technology-integrated Maker Game"* by Shih, Huang, Lin, and Tseng explores an interdisciplinary learning model for developing critical and computational thinking through the utilization of a game-based learning scenario that uses history as the subject.

In *"When Kids are challenged to solve real problems – Case study on transforming learning with interpersonal presence and digital technologies"* Motschnig, Pfeiffer, Gawin, Gawin, & Steiner demonstrate a shift toward experiential pedagogy through the application of the Stanford Design Thinking Method, and the use of Minecraft, Micro:bit, and Lego Education, to let pupils explore different aspects of programming in novel ways.

The papers included in this special issue will hopefully contribute to promote rich discussions and reflections with regard to the emerging possibilities that STEAM offers in combination with novel use of ICT in order to support the transformation of learning and teaching. Hopefully, these novel efforts and endeavours may result in an improvement related to the quality of education.

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