

# Invited Talks

---

## **Programming by Building — Using Robotics in Education**

Henrik Hautop Lund

*University of Southern Denmark, Denmark*

The main aim of our research is to design and develop principles and technologies that allow everyday users to develop complex technological artifacts, and we exemplify this by initial explorative studies of the use in ICT education that would serve the needs in developing countries, in math training, in learning activities for speech therapy in cases of dyslexia and aphasia, and in story telling performed through the construction of physical characters exhibiting emotional states. The studies were performed with children and young people from Denmark, Italy, and Tanzania.

The studies are based upon our development of Intelligent Building Blocks (I-BLOCKS) to support learning by construction and, more specifically, to support “programming by building.” By attaching a number of basic building blocks (each containing a microprocessor and communication channels) together, the user constructs an artifact, which can perceive input, process it, and produce output. In general, the I-BLOCKS are an innovative concept of building blocks allowing users to manipulate conceptual structures and compose atomic actions while building physical constructions. They represent an example of enabling technologies for tangible interfaces since they emphasize physicality of interaction through the use of spatial and kinaesthetic knowledge.

Differently from other approaches, I-BLOCKS do not only specify a computation that is performed by the target system but perform at the same time the computation and the associated action/functionality. Manipulating I-BLOCKS do not only mean constructing physical or conceptual structures but also composing atomic actions into complex behaviors.

Based upon the development of this initial prototype tool kit, we engaged in development of technology in a cultural context. Here, I will describe initial experiences in involving users from Tanzania in the development of I-BLOCKS technology for the African cultural context together with education students at Tumaini University in Iringa, Tanzania. Users of the intelligent building blocks (I-BLOCKS) can do ‘programming by building’ and thereby construct functionality of artifacts in an intuitive manner without the need to learn and use traditional programming languages. We allow both secondary school pupils and university students in Tanzania to investigate possibilities by building with I-BLOCKS within three scenarios, for (1) mathematical training, (2) emotion construction, and (3) language grammar training. Based on the experience, the pupils and students engage in description of future development of the African I-Blocks. Also, the concept of modular building blocks can be used on a larger scale for outdoor activities. For this exemplification, we developed modular processing tiles for a novel playground, which includes sensing and actuation. In this case, the modular system allows reconfiguration of the playground.