# The RoboScratch Theatre: Constructing knowledge with Lego Mindstorms and Scratch through artistic activities

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## Abstract

*This workshop aims at connecting educational robotics and the Scratch programming environment to the concept of theatre. The integration of a tangible concept, such as that of preparing a theatrical performance can provide a new perspective on problem solving activities through programming environments, such as Scratch and Lego Mindstorms. Art holds an important position within the entire school curriculum, for introducing complex concepts to children (Kindergarten) or even for students' bonding, collaboration and socialization. Within this workshop, the tight connection of theatrical performances and Lego Robots, as well as programming with the Scratch environment will be demonstrated, as means for facilitating collaboration within problem solving activities, thus providing a valuable new perspective for the children, allowing them to develop problem solving and social skills.*

## Keywords (style: Keywords)

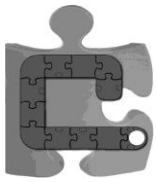
*Lego Robots, Scratch, Theatre, Art*

## Introduction

Educational Robotics is becoming an increasingly researched area, related to the pedagogical exploitation of Information and Communication Technologies (ICTs) in education. The latter is not mainly based on the technological platform/tool used, but rather on the underlying theoretical perspective which allows the utilization of technological characteristics of ICTs, such s recording, representation, management, information processing and transfer. The concept of pedagogically exploiting ICTs mainly involves tasks for the active participation of students and teachers, facilitating interaction among them as well as the creation and/or manipulation of mental models (Mikropoulos & Bellou, 2006). These approaches completely comply with the constructivistic and sociocultural approaches, as they were introduced by Piaget and Vygotsky, accordingly.

Constructivism explores how children construct knowledge, by applying what they already know through their personal experiences to user-centred interactive approaches which introduce authentic problem situations and usually involve collaboration with peers. These approaches allow them to (re-)organize their experiences to knowledge structures (Jonassen, 2000). According to Papert, knowledge construction is more effective when learners are engaged in designing meaningful projects and constructing artifacts. This approach has been established as constructionism and technology provides tools for this design and construction (Papert, 1993).

Educational Programmable Robots, such as Lego Mindstorms, allow the design of approaches



which follow the four main principles of constructionism (Bers et al, 2002; Resnick & Silverman, 2005):

- Learning by designing meaningful projects, creating things and sharing them in community
- Using manipulative objects to help concrete thinking about abstract phenomena
- Identifying powerful ideas, tools to think with from different realms of knowledge
- Learning by reflection

These principles are also facilitated by programming environments which allow the design of authentic problems to be solved in a meaningful way. Scratch (http://scratch.mit.edu/) is an environment that allows 4-12 year old students to program computers by eliminating the technical difficulties of normal programming languages. It integrates Logo-like programming, as originally introduced by Papert, but it is also expandable by connecting to Lego and other sensors, thus providing a more tangible and interactive working environment.

Furthermore, art is a core constituent of the school curriculum, especially in Preschool and Primary Education. From Kindergarten, concepts are introduced to children through puppet shows and learners often follow experiential teaching approaches in class by participating in role playing games, similar to a theatrical performance. By this age, children are experientially familiar with corresponding concepts, such as *actor*, *role*, *script*, *performance*. In any case, it is common for young aged classes to organize theatrical performances at the end of the academic period, thus demonstrating to the parents how their children have progressed through the year.

The underlying idea for this workshop proposal is to combine the aforementioned tools and approaches, thus providing more authentic, realistic and meaningful activities for young learners.

## Description and workshop objectives

This workshop aims at integrating the constructionistic exploitation of educational robotics and Scratch with the concept of a theatrical performance in an attempt to provide a more meaningful environment of teaching activity design for the children. In fact, computer programming through the Scratch environment follows the actual design of a theatrical performance. The programmer has to guide characters (actors) who talk, move and interact on a stage. As a theatrical director, he/she has to properly place the actors on the stage, coordinate them and design the scenery. As a script writer, he/she has to write the script for all these actors. All the above is implemented by joining puzzle-like pieces.

The idea is that teachers as educational designers can exploit the children's experiential familiarization with theatrical performances and movies in order to provide a meaningful environment for the children to be involved in problem solving activities through computer programming and robots' constructing.

The core objective of the workshop is to introduce the aforementioned concepts to the participants and clearly demonstrate their interconnection on both a theoretical and practical level. The objective of the workshop is in agreement with researches results (Rusk et all, 2008), which suggested strategies that have been successful in engaging a broad range of learners. According to them, robotics projects must focus on themes, not just challenges, combine art and engineering, encourage storytelling and aim to support exhibitions, rather than competitions. Also combining craft materials, mechanical parts, and programmable devices can inspire both girls and boys to think more creatively about what is possible and what they want to create (Rusk et all, 2005). New technology, called the PicoCricket (http://www.picocricket.com/), that supports previous strategies developed, which enables students to design and program artistic creations

that integrate light, sound, music, and motion and also exploit familiar objects and material.

By providing hands-on group activities, the participants will be able to understand this interconnection in an experiential manner. Having completed the workshop, the aim is for the participants to be able to design their own teaching activities.

Finally, ideas discussed within the workshop will be collected and expanded, providing material for a collective book volume.

## Workshop outline

The workshop will be divided into three (3) phases. During Phase 1, the organizers will introduce the corresponding concepts through short positional presentations. Specifically, the connection of theatrical concepts and Robot & Scratch programming will be outlined. Then examples will be presented, outlining the differentiation between organizing a theatrical play with children as actors, as opposed to robots as actors. Also the concept of directing a theatrical play as a method of debugging program scripts will be discussed.. The duration of Phase 1 will be 40 minutes.

During Phase 2, the participants will be divided into small groups and attempt to design their own activities, based on the examples presented during phase 1. They will have the opportunity to construct and program Lego Robots, as well as work in the Scratch environment. Participants will use Lego NXT Mindstorms to implement a theatrical play, which requires independently robot development, but also robot motion synchronization and participants' collaboration. Familiar objects and material will be used for art creations and robot suits. Assistance will be offered by the organizers constantly. The duration of this phase will be 45 minutes.

During the final phase, the groups will have to present their educational design. Then, a concluding discussion will follow in order to sum up the workshop and organize a post-workshop collaboration among the participants which will include the construction of a small Community of Practice and a collective volume of educational activities and theoretical perspectives.

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