The AUTh Framework for Research in Educational Robotics: Collaboration Scripts, Metacognitive Skills, Tangible Interfaces and the CPPC+ Model

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Abstract. This poster paper presents concisely the research directions of our educational robotics research group at the Informatics Department of Aristotle University of Thessaloniki (AUTh). This includes (a) a model proposed for organizing educational robotics activities, called "CPPC+" after Collaboration, Problem, Play, and Competition, while "+" stands for supplementary teachers' supportive interventions such as promoting students' metacognitive skills; (b) research on the impact of various collaboration scripts when applied to guide students group robotics-based learning activities; (c) research on the impact of educational robotics on students' metacognitive skills, and (d) research on the benefits from building tangible interfaces (connectable programming "blocks") to help younger children program the robots without necessarily having to use a typical graphical user interface (GUI). In our presentation we shortly comment on the research objectives, the studies conducted so far and our first conclusions.

Keywords: educational robotics, collaboration scripts, metacognitive skills, tangible interfaces.

The AUTh Framework for Research in Educational Robotics

Educational robotics (ER) is a powerful, flexible, teaching and learning tool enabling students to construct knowledge by controlling robots while using specific programming languages [1]. However, although robotics seems to be an excellent tool for teaching and learning and a compelling topic for students of all ages, the pedagogy of teaching with robotics is still in its infancy [2]. In our laboratory (at the Informatics Department, Aristotle University of Thessaloniki), we use ER (with Lego Mindstorms technology) with a twofold objective: (a) to familiarize informatics students with the ER technology and didactic method as a means to organize introductory programming activities as school teachers, and (b) to investigate pedagogically promising didactical models and technologies for increasing the ER learning efficiency. In the following we shortly present an overview of our research efforts highlighting our objectives, studies so far and key conclusions.

The CPPC+ Model. We model the organizational issues of an ER activity through our proposed CPPC+ model. The model suggests that an efficient ER activity should be based on: (a) *Collaboration*: students work in small groups with assigned cognitive or functional roles; (b) *Problem*: the activity should be problem-based, that is, students are challenged by specific simpler-to-complex problems to be solved; (c) *Play*: the activity should encompass a playful perspective, that is, students should be encouraged to think of the ER activity as a playful activity (for example, we call the ER sessions "training" rather than "course lessons", and (d) *Competition*: the ER playful activity should have competitive elements, which are expected to provide motive for engagement (for example, training sessions prepare the ER groups to compete one against each other on a final challenge). Finally, "+" refers to other promising teachers' interventions, such as supporting students' problem solving skills.

Collaboration scripts. Student groups need to be guided in their collaboration by didactic scenarios (scripts, [3]) so that peer interaction becomes an efficient learning mechanism. We have recently conducted research on the impact of various collaboration scripts on ER working groups [4]. Our first results indicate that combining the "Jigsaw" and "Send a Problem" scripts helps creating a highly student engaging setting.

Metacognitive skills. We argue that ER activities should be investigated regarding their potential to increase students' metacognitive skills. Toward this objective we currently conduct research using various metacognition measuring tools (such as KMA and MAI) to explore how specific teacher supportive interventions during an ER activity may help students improve their problem solving strategies.

Tangible interfaces. Tangible programming interfaces for controlling robots may increase students' enjoyment of the activity, help younger children participate without necessarily operating a graphical user interface and may also maximize the learning outcomes. We have developed a set of graspable connectable programming blocks for controlling Lego robots and we have initially explored the usability and enjoyment of the tangible interface when compared to an isomorphic graphical one. Our first results indicate that the tangible interface was more enjoyable and easier to be used in ER activities, especially by children of lower ages (5-7 years old).

References

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