Teaching STEM with LEGO WeDo at primary school

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Background

Educational robotics is one of the most popular and engaging tool for teaching Science, Technology, Engineering and Mathematics (STEM) at school. It is extremely motivational for students because they perceive them as toys rather than as educational tools which is a significant factor for motivating them to engage and learn (Komis, 2005).

The theoretical framework behind teaching STEM with LEGO robotics is constructivism and in particular Papert's constructionism and "learning through play" (Papert and Harel, 1991).

The previous years there was a major reform in curricula concerning ICT in Greece. Curriculum for primary school aims now in computational thinking, visual programming and debugging.

However, educational robotics is being integrated quite slowly in the teaching process.

Reasearch Methodology

We designed and implemented an educational scenario using the robotic kit LEGO Education WeDo for 6th grade pupils. We named it "Programming the pulleys' movement". The main objective of that scenario was to "construct" students' knowledge, skills and abilities, through constructing bricks and programming them using a Natural Sciences' concept, while developing their computational thinking.

We used qualitative data collection and data analysis including observations (fieldnotes), audio-visual materials (photographs and recorded videos of pupils' work and mainly pupils' worksheets).

Our scenario consisted of five phases and twenty-one activities: a) psychological and cognitive preparation activities, b) teaching activities, c) consolidation activities, d) assessment activities and e) metagnostic activities.

We used three projects from Lego: *Airplane* for learning visual programming and debugging, *Dancing Birds* as the main project for learning all about the movement of pulleys and belt and *Hungry Alligator* as the main assessment activity. We also handed over some worksheets regarding prior knowledge assessment, some others as a teaching aid in case the inquiring strategies failed and finally assessment worksheets.

Teacher's role and teaching strategies

In the educational approaches of constructivism and constructionism we followed, the teacher's role is limited to prompting and facilitating the learning process.

LEGO Education
WeDo kit

Airplane

Dancing
Birds

Hungry
Alligator

Being in alignment with the theoretical approaches mentioned, the teaching strategies we used were mainly problem-solving, cognitive conflict and inquiring. The teaching strategies were carefully matched to the teaching aims of each activity. The students worked in groups of two in order to enhance better collaboration and dialogue between them.

Results

The educational scenario made very positive impression on the students, the way of teaching was unprecedented for them as well. They were really enthusiastic working with Lego bricks and they were truly committed to their tasks and activities.

From the assessment and metacognitive activities we presume that most of the aims of our educational scenario were achieved. Students learned how to construct a robot using instructions, they learned what a pulley is, how a pulley's diameter relates with speed rotation and in which direction the pulley would move. They also learned how the position of the belt affects the movement in a system of pulleys (crossed or not). They learned visual programming and debugging using LEGO WeDo software through structured activities. Furthermore, they enhanced their skills concerning collaboration, problem-solving, inquiring and experimenting.

Discussion

Limitations
The current educational scenario was implemented only in one classroom at 6th grade pupils at Patras. We cannot generalize the results of this scenario for the whole population of the 6th graders.

Implications for future research
Our goal is to help the integration process of the educational robotics in primary schools and compare the results of the same educational scenarios implemented in each grade among greek schools at first and then worldwide. So, we seek collaboration with researchers interested in implementing educational scenarios with robotic kits at primary schools in other countries in order to compare the results.

References

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