УДК 373.3:004.38

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ROBOTICS PLATFORMS AND ENVIRONMENTS IN EDUCATIONAL PROCESS IN PRIMARY SCHOOL

As robot technologies develop, many researchers have tried to use robots to support education. Studies have shown that robots can help students develop problem-solving abilities and learn computer programming, mathematics, and science. Today there are a lot of robotics constructors, so teachers should consider and analyze market robots and robotic kits offered on the market. We define five main criteria for selecting robotics constructor and compare famous robot constructors.

Key words: *robotics, robot constructors, primary school, educational robotics.*

Over the last few years, interest in educational utilization of robotics has increased and several attempts have been made worldwide to introduce robotics in school education from kindergarten to secondary school, mostly in science and technology subjects. Nowadays, robotics is considered as a flexible medium for learning, offering opportunities for design and construction against short time and small funds. The newest version of educational robotic technologies, that is the programmable bricks, enable students to control the behavior of a tangible model by means of a virtual environment and make possible new types of science experiments, in which children investigate everyday phenomena in their lives (both in and out of the classroom) [1].

However, the successful introduction of an educational innovation in school settings is not just a matter of access to new technologies. Technology alone cannot affect students' minds and cannot act directly on learning. Appropriate educational philosophy, curriculum and learning environment are some of the important factors leading any educational innovation to success. In view of the above, before teachers and educators at all levels rush to exploit robotics in education, appropriate teaching methods need to be formulated and incorporated in the school curricula, given that most schools and teachers lack not only experience and resources, but, also, in most cases, they have to operate under a directive school curriculum that does not favor educational innovation. As M. Martaric points out, 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 robotics (we would add the pedagogy of teaching with robotics as well) is still in its infancy [2]. We think first of all teachers should be aware of existing robotics platforms and environments. There are not many achievements in this area in our country.

However, we have clubs on robotics for kids like "Vynahidnyk", Ukraine has a team of students participating in international competitions "RoboTraffic" etc. However, teachers of ordinary schools pay little attention to this trend because of lack of technical support, methodic accompaniment. Therefore, this work aims to explore different robotics platforms and environments, which can be used in learning process.

O. Armitage, D. Hait, A. Kobak, M. Lazarev, M. Kabanova, V. Ilieva, S. Val, M Jacek and others deal with the use of robotics in education. Before analyzing robotics platforms, we should answer such questions: Do children learn anything from robotics? Is this different from other ways of learning? What should be robotics constructor?

There are several important reasons for exposing young students to robotics. There is no doubt that many children and adults find robots fascinating. Sales of affordable robot toys and robot construction sets are reaching unprecedented levels. As our world becomes increasingly technological, students need experiences at an early age that enable them to become comfortable with and knowledgeable about technology. Robotics can often do this within a context students care about. This is especially critical for female and minority students, as positive early exposure may contribute to persistence in STEM courses and possibly careers [3; 4]. Robotics is an attractive approach to technology education

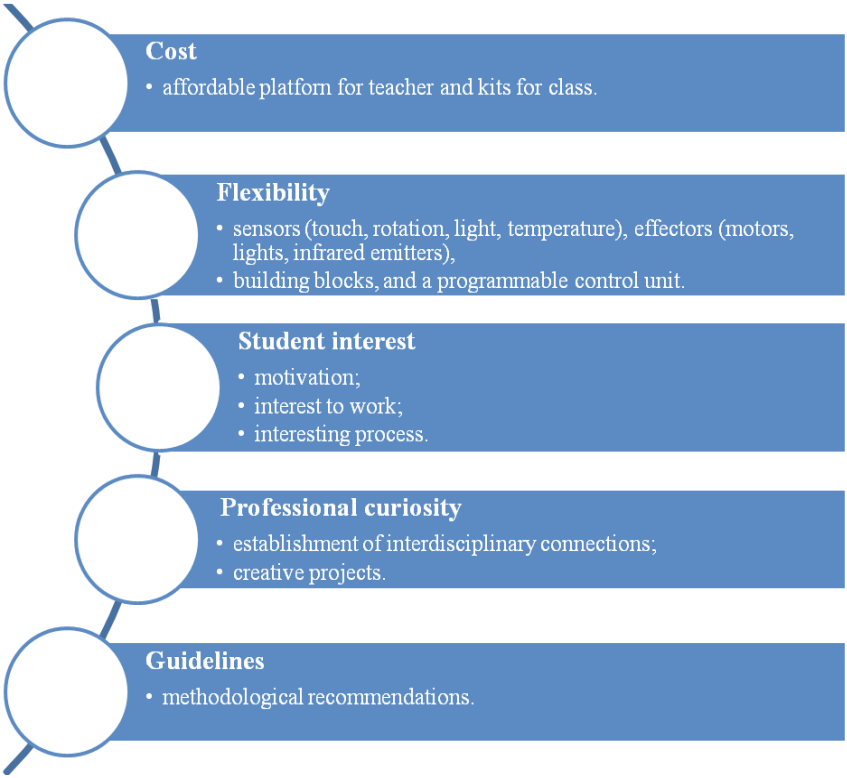

Fig. 1. Criteria for selecting robotics constructors

because of its interdisciplinary nature, requiring expertise in a range of fields from mathematics to aesthetics.

At the beginning of learning process of robotics, teachers should consider and analyze market robots and robotic kits offered on the market. Today there are a lot of robotics constructors. However, how can we choose the most suitable platform?

There are five main criteria for selecting robotics constructor (*Figure 1*)

We did some research and compared different constructors. A MoWay [5] is an autonomous, small, quick robot equipped with attractive sensors. It has the programming language named MoWay.

One of the advantages is tutorial and methodical materials for teachers, which are free to download. However, we think that a Moway with its programming language is not suitable for first-grade pupils in elementary school. This robot cannot change its shape which is considered a disadvantage.

A FischerTechnik Universal 3 [6] is a robotic kit developed by FischerTechnik. It is rather focused on models and constructions. A FischerTechnik Universal 3 does not support any programming language. This set provides pathway for introducing younger pupils to everyday technology and to enable them to understand how the things around them actually work. Pupils can build numerous models. Several models can be built simultaneously.

The Edison robot [7] is an innovation from Microbric, an Australian company based in South Australia. Microbric has been providing educational products to schools since 2004. Edison can navigate his way around using infrared light sensors to see obstacles to his left or right, can learn commands from just about any remote control and can drive forward, backward, turn left, turn right, spin left and spin right. In addition, this constructor can follow a line or stay within a boarder using his line-tracking sensor, detect fridge intruders or follow a flashlight using left and right light sensors, play beeps and musical tunes, respond to clapping and other loud sounds. Two or more Edisons can communicate using infrared light. Edison is driven by two wheels that give him full manoeuvrability. Each wheel can drive forwards and backwards at a wide range of speeds. Constructor has two red LED lights at the front. With just three buttons, Edison is easy to control. Edison is programmed using EdWare, a drag and drop graphical programming language that is easy to learn. EdWare is free and open source and works on Windows, Mac and Linux computers.

A PicoCricket [8] is a tiny computer that can make things spin light up, and play music. User can plug lights, motors, sensors, and other devices into a PicoCricket, then program them to react, interact, and communicate. Also pupils can use a wide variety of materials to create their own robotic models. But from a practical point of view, a PicoCricket is very expensive kit to buy, which is considered a huge disadvantage. It is very important that robotic kit is available on the market and for a reasonable prize to be available for schools.

A LEGO WeDo™ Construction Set [9] is a classic set designed by Lego. It is a set of pieces and mechanical parts used to build and design LEGO models. The construction contains robot bricks, two sensors, LEGO USB hub and a motor. The set comes with easy-to-use icon-based software providing an intuitive programming environment with building instructions, programming examples, activity tips. Nowadays a LEGO WeDo™ Resource Set [10] has been developed. The set allows to build more complex and interesting LEGO models or constructions.

The possibilities and variety it offered prevailed over its shortcomings. One of its advantages is the software and Activity Pack which contains simple guides for building models, either from imagination or by instruction.

According to V. Ilieva, the fact that pupils learn through action is very important [11]: "Working with LEGO constructional material the children come to know the surrounding world by recreating it." In a different article [12], the same author mentions another advantage of using LEGO sets: "The lessons in robotics gives the teacher themes and situations that make teamwork appear absolutely natural. So the children will agree to subordinate their own wishes to the aims and objectives of the whole team." This attribute of robotic sets of bricks used during tuition is considered convenient, since most of our schools are unable to supply each pupil with a separate set of bricks, hence pupils work in teams.

LEGO WeDo can be also programmed through the freeware programming environment Scratch that provides a variety of attractive tools, and recently experienced a significant increase in its usage as available alternative to Imagine.

We find original LEGO WeDo software complex enough and has another advantages: absence of extra advanced elements, simplicity of environment, easy to use iconic design and absence of any textual instructions.

Generally, work with robotic kits is not very particularly widespread in educational process in primary school. We didn't found much information about work with robotics platforms in primary schools. It is possible that our search will continue and robots constructors will be more used on the computer science lessons.

We believe that teaching with educational robotics is an attractive form of education for many pupils. It contains motivational element itself

and provides many unexplored opportunities for pupils' development. We are sure that this is the spot, where pupils can see and understand the link between real physical world and abstract programs. We perceive educational robotics using tangible objects is the easiest way for children to understand programming language.

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