

STANCE ON ROBOTICS AS AN INNOVATIVE EXTRACURRICULAR ACTIVITY AT THE MIDDLE SCHOOL STAGE OF BULGARIAN SCHOOLS AND WHETHER ITS REALIZATION IS FEASIBLE

Petya Delcheva, Stefka Aneva, Elena Todorova

Abstract. *In this current paper are presented some basic aspects regarding an experimental study on robotics that was organized and conducted with students from the 5th grade of a given school under the form of an extracurricular activity under the project Classes by interest. For that goal a preliminary query research was conducted regarding the stance on studying robotics from the students. A summarized analysis is presented for the obtained results from the research and the certain specifics of distribution of the obtained responses in the query according to the factors of gender and type of class are discussed.*

Key words: programming, robotics, educational technology, information technology.

1. Introduction

The modern development of technologies is beginning to have its impact on school teaching. One of the directions in Informatics and Information Technologies which is gaining popularity over the last years, is Robotics. It is a branch of technology, machine-building, electrical engineering and informatics which includes the construction, management and use of robots as well as computer systems needed for their control, reception of data from sensors and its processing [1]. Robotics is a fast-developing sphere which finds a broader application for different purposes in many areas of everyday lives. The idea is for robots to stand in for people for a number of activities which can be automated – in production for a number of production processes, in surgery, weapon industry, in life- and health-endangering activities, in everyday lives, et al.

Studying Robotics as part of one's education would aid in increasing interest among students towards computer sciences and a better understanding of abstract knowledge in the field of programming, understand-

ing the need to study sciences such as Information Technologies, Physics, Mathematics as well as forming skills which are useful for one's future professional realization.

The expected benefits in studying Robotics at school are forming engineering thinking among students, creating a lasting interest towards technologies, developing mathematical and logical thinking as well as getting to know some of the basics of programming. In the future this could create an opportunity for more engineering professions and lead to a bigger number of specialists in the area of Information Technologies. In the learning process besides technical skills the students are expected to develop “soft” skills such as communicating as a team, problem-solving opportunities, tolerance, consistency, responsibility, adaptiveness, creativity, et al.

Despite the aforementioned benefits there is still no detailed and developed commonly accepted methodology and directions for teaching Robotics since the field has yet to feature for mass studying in schools. Some of the reasons for this could be the novelty of this area, the need for specialized knowledge in different areas as well as the cost of robotics kits.

A number of authors in their scientific papers discuss some aspects about the application of Robotics in teaching Computer Sciences and share their experience in teaching students by using different programmable devices [1, 2, 3, 4, 5] and others.

2. Researching the stance among students from the 5th grade on studying Robotics as an extracurricular activity and conducting the teaching process

During the 2019/2020 schoolyear in SU “Sveti Patriarh Evtimii”, Plovdiv an experimental class teaching Robotics for students in the 5th grade under the form of an extracurricular activity was held under the project “Classes by interest” with a runtime of 70 academic hours. To that end:

- a query research was conducted to establish the stance among 5th grade students towards Robotics;
- a learning curriculum was created including a set of problems for the organization and conduct of the teaching process.

The goal of this research and class was to find out whether Robotics is

suitable for students in the middle school. The course itself was organized and held by one of the authors of this current paper – Petya Delcheva, a teacher in Informatics and Information Technologies in the same school.

At the start of the schoolyear a query was held with 132 students participating from 5 classes (2 classes with a mathematical profile, 1 class with the profile Bulgarian Language and Literature and 2 classes with a general education profile). The number of students participating from both genders is equal.

In order to determine the potential options for answers from the students one of the Information technologies classes was held as a discussion about their desire to participate in extracurricular activities having to do with programming Lego robots. Based on the obtained results from the students a summary was made and the final version of the query was formed.

During the results analysis the following two factors were taken under consideration – type of class and student gender. The summarized results from the research are presented in Table 1.

Would you be willing to enroll in an extracurricular activity by interest having to do with programming Lego robots?		
I am willing!	55	42
I am willing but I do not have the time, I attend a number of classes and my parents will not allow it!	29	22%
I am willing but I will not enroll since I do not feel good enough in computer sciences and I do not have the necessary material base to work on what was learned at home.	13	10%
I am not willing as programming is something I would not do in my spare time.	35	26%

Table 1. Summarized results from the research

The obtained results show that most of the students showed interest towards the class but 1/3 had a reason to not enroll in it. Often the reasons for this are attending too many additional classes by the students, prejudices by the parents towards modern technologies or directing the students towards classes they deemed more important for their future such as Mathematics and Bulgarian Language and Literature. Another reason could be the lack of their own device (computer or tablet) as well as insecurity in working with digital devices. The results analysis shows that 1/4 of students show no interest towards Robotics and as the diagrams below show,

in that case the two factors (type of class and gender) are also important.

In analyzing the obtained results according to the factor gender (Figure 1) you could find that a significantly larger part of boys have the willingness and desire to enroll whereas 39% of girls answered that they had no interest in programming.

In analyzing the obtained results according to the factor type of class (Figure 2) you could find a larger interest among students from mathematical classes compared to those who study additionally Bulgarian Language and Literature.

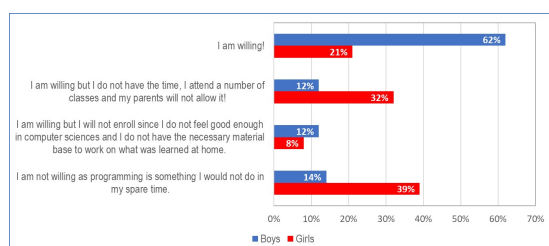


Figure 1. Diagram showing the students' opinion according to gender

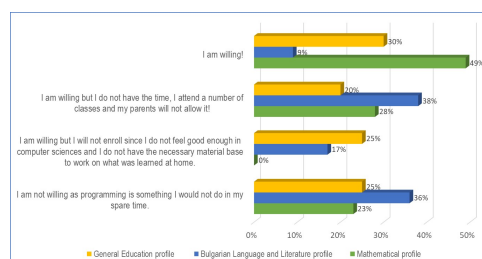


Figure 2. Diagram representing the students' opinion according to type of class

After the short query was conducted the selection of students followed who would participate in the planned class by interest. Its target size was around 12 students. The 55 students who showed interest were introduced to the basics of Robotics and what would be studied in those 70 academic hours, in what day and time the classes would be. Some of the students were eliminated due to unavailability at this particular time and others – after declarations that needed to be filled out by the students and their parents. The selected students had actively participated in the Information Technologies classes.

Here is how the final distribution of the group after the selection looked according to the two criteria (see Table 2 and Table 3):

Girls	Boys
25% (3)	75% (9)

Table 2. Group distribution according to gender

Profile		
Mathematics	Bulgarian Language and Literature	General Education
7	1	4

Table 3. Group distribution according to type of class

The resulting group had the following question posed to them before the official start of class – “What are your expectations that you enroll with in the Robotics classes?”, after having the choice of several of the following answers:

- To learn how to program;
- To have fun;
- To meet students of my age who share similar interests;
- To improve my IT skills;
- To improve my teamwork skills.

In Figure 3 are given the answers to that question.

The entire group expected to feel good and have fun in the classes, most of the students expected to improve their IT skills and to meet students of their age who shared similar interests and learn how to program. A small number of students enrolled expecting to develop their teamwork skills.

In the Robotics classes we used 3 sets of Lego Mindstorms EV3 robots and 13 laptops with Touch Screen displays. Lego Mindstorms EV3 is a set of 600+ Lego parts which can be put together in different ways to form robots with different functionalities. The programmable part of the set is Brick. It connects via a USB cable or via Bluetooth and receives the executable code to perform various actions. The code is scripted in a specialized free block-based software EV3 Classroom App [6].

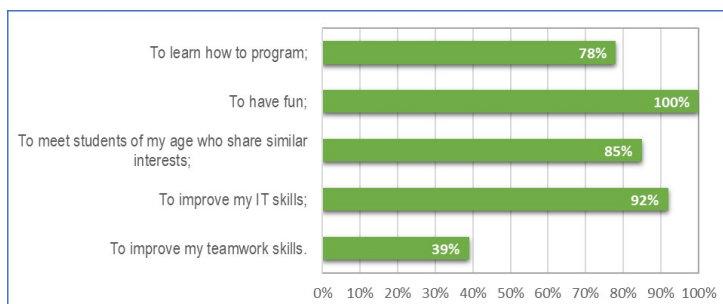


Figure 3. Percent comparison of answers by the students on why they enrolled in the class



Figure 4. A set of Lego Mindstorms EV3

The students were highly motivated and in the form of a game based on a number of problems each one was successfully able to:

- assemble the robot from Lego parts;

- understand and be able to work with the specialized application for programming the robots;
- create motion through the program in some geometric shape and execute a sequence of movements given by the teacher.

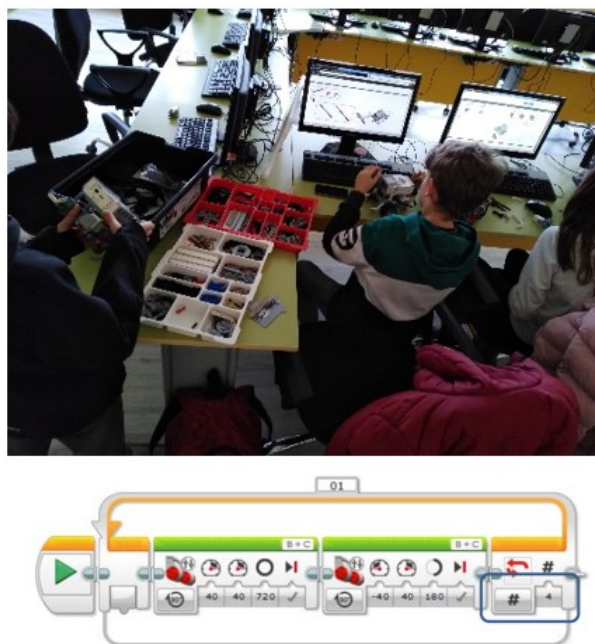


Figure 5. Teamwork on assembling and programming the robot

For the course needs the teacher Petya Delcheva designed a model learning curriculum and a set of learning problems with various levels of difficulty which were tested during the classes. In the proposed learning curriculum the following topics were examined:

- Constructing Lego robots;
- Programming a strictly defined movement;
- Using a cycle;
- Turning on motors and sensors;
- Execution of missions.

The analysis on the research allowed us to make a number of conclusions:

1. The students from the middle school are interested in studying Robotics at school;
2. They do well with assembling and programming the robots;

3. The grounds for the lack of mass learning of robot programming at school are the following:

- Prioritizing other subjects such as Bulgarian Language and Literature and Mathematics both from the students and their parents to computer sciences;
- Lack of computer devices and work sets for robots in a large number of Bulgarian schools;
- The novelty of this area of computer sciences and lack of established learning curricula, exercise problems and an overall methodological toolset in aid of the teachers.

After conducting the learning in the classes by interest and based on observations during school classes and gained experience certain corrections were made on the already tested teaching methodology. For the 2021/2022 schoolyear we planned the formation of a new group to test the improved methodology, upgraded learning curriculum and set of problems. In the learning process the success of the group will be monitored.

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