Journal of Control Science and Engineering 4 (2016) 90-94
doi: 10.17265/2328-2231/2016.02.005

Robotics and Mathematics in Citizenship Formation: Associating Negatives Numbers and Education in Traffic

Hutson Roger Silva[1], Suselaine da Fonseca Silva[2] and Jéssica Ramos da Silva[3]

1. Faculty of Mathematics, Federal University of Uberlândia, Cep: 38400-000, Minas Gerais, Brazil

2. Faculdade of Education, Federal University of Uberlândia, Cep: 38400-000, Minas Gerais, Brazil

3. Federal Instituto Triangulo Mineiro, Uberlândia, Cep: 38400-000, Minas Gerais, Brazil

Abstract: This article reports the experience of the robotics class taught by a student's degree in mathematics from the Federal University of Uberlândia, as a requirement for completion of the discipline supervised training. The Mineiro Baptist College was chosen in the city of Uberlândia-MG to carry out this work because it is a school that entered the discipline of robotics into their curriculum. The class was held with the students of the seventh grade of elementary school second, linking the areas of mathematics, robotics and traffic education, prioritizing the respect of the contents worked in math classes and civic education of individuals in a dynamic and creative way.

Key words: Robotics, mathematics, education.

1. Introduction

One of the major current educational concerns is related to the processes of teaching and learning in Brazilian schools, once the evaluation of basic education data is available showing some discrepancy between Brazil and other countries. Data from Prova Brasil, NSDIB (national system for basic education evaluation) and the school census itself are used to compose the EDIB (education development index basic) to establish biennial goals that can raise these numbers. Universal research, such as the PISA (programme for international student assessment), put Brazil in a difficult position when it comes to the development of learning. The areas addressed in these assessments include, primarily, the teaching of mathematics and reading as fundamental references for the production of knowledge.

The lag prerequisites of the students in the final grades of primary education related to the field of Mathematics is a real problem and indicates an urgent need to take measures to minimize this situation. The result of some of these assessments shows that students of final grades are still not mastering basic math operations that should be understood in the early grades. This problem is not so recent, since for decades the concern with the teaching of mathematics has occupied a prominent place in pedagogical and academic discussions. According to the studies of Cabral and Moretti [1], mathematics is the subject that contains the highest failure rate and poor performance in schools and described by students as a matter that has a high degree of difficulty and that generates discomfort and disinterest.

In addition to this fact, many teachers limit their own actions in the classroom, preferring to use the traditional model, which consists of only explaining the mathematics content and reinforce it with strenuous exercise, not prioritizing the construction of knowledge by their students. Thus, many students cannot memorise the subject, and because of the lack of incentive, totally lose interest in learning putting obstacles in advancing their learning. Freire [4], states that

Corresponding author: Suselaine da Fonseca Silva, M.Sc., research fields: Educação Matemática and Robótica.

The rote memorization of the object profile is not true learning object or content. In this case, the student works more as an object of transfer of the patient or content than as a critical subject, epistemologically curious, which builds the object of knowledge or participate in its construction. It is precisely because of this ability to apprehend the subjectivity of the object that we can not rebuild a bad learning in which the student was pure patient knowledge transfer made by the educator (Freire, 2004, p. 69).

This statement reinforces that mechanical reproduction exercise is not ideal to promote the construction of knowledge and contextualized activities are important in this process to give meaning to learning, especially in math content.

Arising from this learning dynamics ideology and the support that Batista Mineiro College offers to the work of robotics in their school space, we tried to establish a way to associate the math content to robotics classes that take place every two weeks at the Primary 2, constituting connection and promoting dynamic classes, in which the production of knowledge was prioritized.

The educational robotics is a comprehensive universe and to associate it to the mathematical content can be of great value in the teaching process. The robotics classes enable various actions and studies within the mathematical universe, thus the consortium between the two allies to the interest of students can provide meaningful learning moments. The main goal in a robotics class is to encourage students to work collaboratively in the assembly of mechanisms and programming of actions for the operation of its system, giving priority to socialization, teamwork and learning that brings together science and technology [2].

Based on these considerations on the teaching of mathematics and educational robotics, a lesson that, besides working with certain content, could combine the installation of a mechanism that would provide the awareness of students about traffic education was planned. For the development of activity, LEGO mindstorms © NXT kit consisting of a set of several pieces ranging from bricks, plates, wheels, pulleys, sensors, motors, gears, and other miscellaneous parts were used. The class aimed at the cooperation between mathematics and the citizen education students would happen. Some authors claim that mathematics can be worked in favor of the civic education of the individual, as Newton [3] who states that "The teaching of mathematics can contribute to social change through political dimension of the relationship between the mathematical content and the form of its transmission-assimilation itself". Yet, Vygotsky [3] demonstrates that mathematics learning should be seen both as an individual building process and as a process of inclusion in the mathematical practices of the wider society. So, we tried to establish a connection between these three components-content of negative numbers, educational robotics and traffic education-to a fun and creative class that will be presented in the next section.

2. Implementation of the Class

The lecture with negative numbers did not review the content in details, as on the date scheduled for the implementation of the activity the teacher had already taught content. To add negative numbers, students should first understand the construction of the set of integers as a necessity in the historical process and the first perceptions were duly worked in the classroom, establishing the connection between the student and this universe. At the beginning, the content already taught in the classroom by the teacher was revised, providing verification of pre-acquired knowledge by the students. Negative numbers were presented to the students as a "debt", taking as example the balance of bank accounts that simulate operations with integers. The following situation was proposed to begin the next class: "If someone deposits in my bank account R$700 is this value positive or negative? However, if you need to withdraw R$500 to pay a rent, will this

value be positive or negative?" In this case the students answered that the first value would be positive and the second negative and that ultimately result in a positive value of R$200 balance in the bank account. Other calculations were proposed informally through problems involving bank balances, increasing the level of difficulty to each new situation. The proposed problems contributed to reminding the students of operations with integers before presenting the lesson itself.

After this review, students were divided into groups in the robotics lab and were given an assignment that was based on a text taken from internet that brought information about traffic accidents. Numerical data were replaced by expressions involving integer operations. For example, the text said "Of all the 256 fatalities recorded in that year, 107 victimized pedestrians-and 36 took the lives of people with 60 years or more". This text has been replaced by: "Of all the (-7 + 7 + 256) fatal accidents recorded in that year (-500 + 700 + 7-100) victimized pedestrians-with (-6-5-3 + 50) taking the lives of people with (-100 +120 40) years or more". So the students were motivated to perform the calculations and only after the correct completion of the paragraphs of the text they could go to the second stage of the class.

At the end of the activity, the assembly of the "Pega-Pega" car was assigned, in which each group should follow the manual steps used in robotics classes. This car has a design capable of turning on corners and goes through certain paths according to the desired setting. After the assembly, the groups made the programming using the software mindstorms © NXT to provide movement to the car following a series of orders awarded by the students freely. The groups tested the cars on the test table and remade the programming until they achieved the desired movement.

In the last step, a reflection on the text focusing on the amount of traffic accidents involving alcohol and the importance of raising awareness of this fact was performed. The students went to the test table, which was marked with a path and where there was a car of the same model assembled by them and pre-programmed by the teacher to simulate the performance of four types of drivers: a drunk, a high-speed, a cell phone user at the wheel and attentive driver to traffic. The car with the four programming was tested. The speeding car and the driver using the cell could not hold the second curve, with the car at high speed being at a speed that was higher than the allowed, so that it could not be kept in the crosswalk. The car with the programming of the drunk driver held his course in curvilinear movements and did not respect the crosswalk. Finally, only the conscious driver could go all the way.

Amid these statements and reflections, the students share stories of accidents in traffic they passed or a family member has been involved, often reporting the same reasons given by the text such as irresponsibility

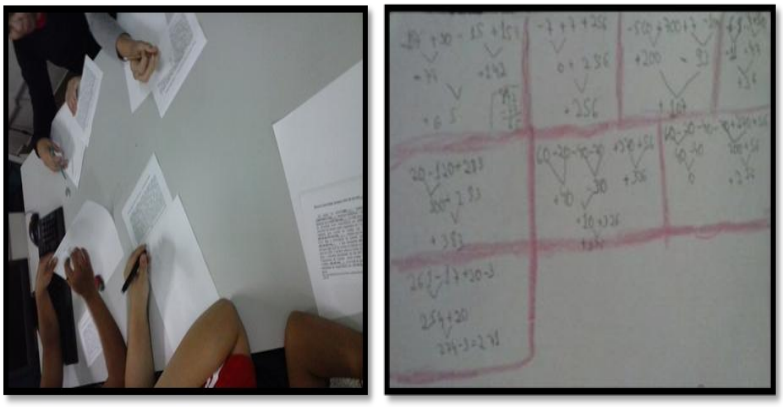

Fig. 1 First stage: text fill.

Fig. 2 Second stage: installation and programming of the robot.

Fig. 3 Third stage: reflective class.

when driving a car. Finally, they demonstrated using their own words that they are aware of the importance of taking responsibility in traffic, preserving the safety of both pedestrians and drivers.

3. Final Considerations

After discussions on accidents caused in traffic for the irresponsibility of drivers, the students concluded that the issues on traffic awareness of issues were of an emergency nature and should be put into practice by everyone. Students also recognized the risks that the direction of vehicles by people who are intoxicated, using mobile phones or at high speed could cause in the midst of traffic and, therefore, attention should also be redoubled by pedestrians, cyclists in the traffic in the streets.

Amid the discussions and resolution of group exercises, students had no doubt; Proof of this was

the large number of hits obtained in the calculations and few errors computed mostly for lack of attention.

Besides, the class was given in a dynamic and participatory manner, which raised the level of interest from students who had made their contributions during the steps, carrying out the activities. The moment when the robot was assembled and its programming was awaited by the students with huge expectations, generating a greater commitment of the group to solve calculations and complete the first part of the class. As students are already accustomed to the class of robotics, there was no doubt in car assembly and not in the robot programming to perform the actions desired by the group. The interest of the students during the assembly of the mechanism and its programming was evident by the level of commitment of everyone.

In fact, robotics is a powerful tool that can be used to make the classes of other subjects, such as mathematics, more dynamic and attractive to students. In the case of the class reported in this paper, by combining the contents of integers to education in traffic and with it being mediated by the use of robotics as a resource, it could be concluded that the proposed objectives were achieved and that the actions established for each step of the lesson resulted in meaningful learning that will surely be remembered by the students as a rewarding and enjoyable experience.

The results confirm the need to promote different moments in the classroom to allow students to participate actively in building their knowledge and to arouse students' interest in issues that contribute to the formation of the citizen. It was also proved that the use of robotics to establish the connection between content from other areas and topics of training of citizenship is a methodology that can generate good results for learning.

References

[1] Cabral, M., and Moretti, M. T. 2006. "The Use of Games in Teaching Math." http://www.pucrs.br/famat/viali/tic_literatura/jogos/Marcos_Aurelio_Cabral.pdf.

[2] Cambruzzi, E. S., and Rosemberg, M. 2013. "The Use of Educational Robotics for Algorithms Teaching." http://www.eati.info/eati/2014/assets/anais/artigo4.pdf.

[3] Duarte, N. 1991. "The Political Commitment of the Educator in Teaching Mathematics." In *The Social Formation of Mind*, edited by Vygotsky, L. S. São Paulo: Martins Fontes.

[4] Freire, P. 2004. *The Importance of the Act of Reading*. São Paulo: Cortez.

[5] Pozzebon, E., and Frigo, L. B. 2013. "Robotics in Teaching and Learning Process." http://www.icblconference.org/proceedings/2013/papers/Contribution42_a.pdf.