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# PRACTICES WITH EDUCATIONAL ROBOTICS IN PROFESSIONAL AND TECHNOLOGICAL EDUCATION

***,[1]Josualdo Dias, [2]Cristiano Gonçalves, [2]Susana Silva, [1]Débora Abdalla and [2]Hugo Saba**

[1]Graduate Program in Computer Science - Federal University of Bahia (UFBA) Av Adhemar de Barros Ondina Campus. - 40170-210 - Salvador - BA - Brazil
[2]Applied Research and Innovation Center - University of the State of Bahia (UNEB) Highway Alagoinhas / Salvador- BR 110, Km 03 - 48000-000 - Alagoinhas - BA - Brazil

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**ABSTRACT**

Robotics demonstrates a huge potential as an educational and interaction tool because it allows that content discussed in class can be worked in an interdisciplinary way to solve recurrent problems in the daily life of students. It allows students to contribute to the actual construction of knowledge through learning themes already covered in the school with the robotics, encouraging them to research and to participate in scientific events that demonstrate their knowledge and their life experiences, contributing to the social and educational transformation by the interaction with technology.

***Corresponding author***



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## INTRODUCTION

According to Pierre Lévy (1993), new ways of thinking and living are being elaborated in the world of telecommunications and informatics. As well as the emergence and improvement of non-existent jobs in the past, the ability to develop new skills became essential to handle the developing technologies. Papert in his constructionist theory advocates, "The most important skill determining a person's life pattern has already become the ability to learn new skills, to take in new concepts, to assess new situations, to deal with the unexpected." (Papert, 1993). In this process of change, robotics, considered the science of systems that interacts with the real world (Martins, 2006) only present before in the industry, starts to be used in classrooms, not only in universities, but also at primary and secondary schools. The use of educational robotics kits inserted students in a new teaching way that according to Chella (2015) contributes to the formation of new skills in promoting direct contact with current technological sciences, allowing its construction or deconstruction, not only in the tangible meaning, but also intellectual sense, by the fact that they understand the knowledge created by human beings. Benitti demonstrates that educational robotics has huge potential as a learning tool, including support for teaching subjects that are not directly related to the field of robotics (Benitti, 2012). The study conducted by Benitti compares several application projects and the use of robotics in the school environment, such as Owens (Owens *et al.*, 2008), which enabled greater social interaction and helped the learning process for autistic children. From the perspective of the intervening project entitled "Basic and Educational Robotics", which inclusion Educational Robotic (ER) practices were executed at the Territorial Center of North Coast Professional Education and Bahian Agreste in Alagoinhas, Bahia, Brazil (CETEP / LNAB). Its goal resolves in enabling new technology learning in accordance with other knowledge areas for the popularization of science (Dias *et al.*, 2015), the action of this study is contextualized. This intervening project consists of two different focuses, but related. The first focus is based on the introduction of robotics as an educational resource, besides the courses from the

Technical Course in Informatics, Vocational Education modality Integrated to High School (EPI), promoting interdisciplinary activities between the courses and following the principles of active methodologies and problem-based learning (PBL). The second proposes to teach robotics to students aged between 15-18 from the Technical Course in Informatics in a practical way, following the same methodological principles, using the free robotics, which are characterized by the use of free solutions to replace commercial products (César, 2014), contributing to the enthusiasm in the learning process, effective participation in disciplines, recognition of skills and capabilities development. This paper will present the project by the second focus of the application's proposal during the first two years that will be implemented. The first focus of the project was not successful in its first year because of the lack of participation of teachers in the integration of robotics in the content that they teach. The structure of this article, besides the introduction (section I), is divided into 3 more sections. The Section 2, Intervening Project Practices, presents the steps it had to be taken in order to develop the project activities. Aspects of the school, course and classes chosen for the development of the project actions are examined in section 3, "The School, The Course and Actions Developed". Finally, section 4, the conclusion, presents the contributions of the first year of implementation and expected results for the future of the project.

## Intervening Project Practices

The Basic and Educational Robotics project aims the creation/adaptation and implementation of a teaching methodology focused on the use of educational robotics through the free robotics practice, using as reference teaching methods already known and widespread in the educational environment as the expositive method (de Ferro, 2004), the interdisciplinarity, which according to Assmann (1998) there are successive interventions of different courses in the same project, and the Based Learning methodology (Problem-based learning-PBL) (Boud and Feletti, 1999). The PBL methodology, according to Boud and Feletti (Boud and Feletti, 1999) is a learning strategy focused on the student, and the problem as the object of motivation and this is independent and interdisciplinary. Within the characteristic features of PBL, interdisciplinarity is explored through the search for solutions to problems proposed in the methodology. For Japiassu the use of interdisciplinarity demonstrates the actual use of the subjects taught at school. "The interdisciplinary is characterized by the intensity of exchanges between experts and the degree of actual interaction of the courses within the same research project" (Japiassu, 1976).

According to Almeida: "When developing projects in the classroom, it is important to raise issues related to the reality of the student, whose issues and thematic in studies comes from the knowledge that he brings and try to develop research to build a scientific knowledge to help this student to understand the world and to critically live in society" (Almeida, 2005). The first step consisted in the recognition of the educational environment. At this stage, the quantitative data about the school performance of students was gathered, approval ratings of teachers by students, socioeconomic levels and the level of knowledge on technology with emphasis on robotics. Data were obtained through passive observation with filling observation form, questionnaires, application of knowledge assessment based on the Theoretical Modality of the Brazilian Robotics Olympics (OBR), both developed and applied by the executing team. Some data were provided by the school administration, as the scores obtained in the courses. After assessment of the school environment, the works focused on the practice of the methodology insertion were initiated through research and tests of viability and efficiency, through "pilot workshops" exploring introductory content from Robotics. In the second stage, the graduate members of the project and involved in the adaptation of activity for the courses through PBL and interdisciplinary, showed the proposals to the adequacy of the syllabus courses, attaching to this integration between courses and the robotics subjects. The schedule of activities was prepared alongside the school board when dates were defined for lectures and practical workshops to participating teachers. The practices would be developed using the syllabus and with the participation of teachers, thus after teaching a certain content, it should be exemplified and/or tested with the use of robotics. In courses like physics, for example, where contents could be related to the bodies' movement, mobile robots can be used to exemplify the principles and causes of movement, as well as history, philosophy or sociology open discussions about robotization of industries making a reference to the Industrial Revolution in the XVIII century. In the third stage, competitions and projects to motivate scientific research were introduced in the school environment after a period of preparation of students with specific workshops for this purpose. The rules and competition advertising were prepared by the project researchers, which, in addition to certify and evaluate students, it also allowed the development of social and educational aspects like teamwork.

## The School, the Course and the Actions Developed

The project is being applied in the Territorial Center of North Coast Professional Education and Bahian Agreste - CETEP / LNAB in Alagoinhas, Bahia. From the courses offered by CETEP / LNAB, the Informatics Technician (IT) course in the Integrated Vocational Education (EPI) modality was previously selected for the development of the proposed activities. This choice was not only based by the fact that this course already involves technology in its essence, but also because it has an appropriate curriculum to the popularization of science in the technological field. The project began in the second semester of 2014 with estimated conclusion in the first semester of 2016. It was decided by the executing team and approved by the Pedagogical Office and Coordination of the Technical Course in Informatics, the observation of two classes of same grade by the project duration period from the 1st year (2014) to the 3rd Year (2016). The choice regarding to monitor classes in the same grade, and these being in the initial series of the course, was exact the period that they stayed in the course, average of 4 years, which is the minimum time to completion. Because they just stepped out of elementary school, the students begin a new practice without having experienced the practice of teaching without the project proposal insertion. In the first step, the passive observation period was a support measure for the School Environment Recognition step. In this way, it served as a preview of what to expect for the application of workshops and even for that students could get used to the presence of other people in the classroom, in addition to teachers. During this period, we began the analysis of the profile of the classes, 1st Year IT V1 and V2, which were complemented by the time we completed the analysis of tabulated data. The observation brought us closer to the school environment and we have observed the

students and teachers' routines, identifying challenges to the project and how to awake the interest of students. Not only for the project and it's practice, but also for academic experiencing. In addition, before exposing the robotics and its practice we would have to work the principles of cooperation, respect, and mainly, trying to extinguish the fear of making mistakes. After the conclusion of the observation period, the preparation for the activities that the project requires started. Mechanisms have been developed for data collection on classes and students participation in the project. Therefore, we developed a questionnaire to identify educational and socioeconomic data. Before applying the questionnaire to all classes of 1st year of the evening period, we did a test with 5% of the students from class. Once it was noticed the understanding of students and the effectiveness of the questionnaire, this test would be applied. We applied to all the classes, making small changes to simplify understanding the issues.

The assessment of knowledge followed the patterns of the issues of the theoretical modality of the OBR containing issues for different years and levels. The OBR test follows by different cognitive axis, always using robotics to elucidate everyday situations or a view of the implementation of this technology (Brazilian Robotics Olympics, 2014). The classes are composed of approximately 43 students, with a percentage of 65% male and 35% female. Among boys, the average age was 15 years, while girls' was 16. Students consider themselves curious and with willingness to learn new things. This analysis have given us feedback to apply workshops before step 2 to verify the acceptability of the students on the content of robotics without the inclusion in the courses and implementation of practical projects. Although students have demonstrated interest in learning new things, they did not have technical knowledge for the immediate construction of practical projects. In these terms, it was presented practical work developed by third parties to illustrate the next steps of the activity of the workshops in the second stage, besides the constant incentive for construction of tasks inspired by the models presented in future actions. The content worked in five workshops have acted as an introduction to the issues that will be worked on next steps, as Robot and Robotics Applications and Concepts, History of Robotics, Creativity, Robots Classification and Robots Morphology. In the first stage (2014), where workshops applications have already happened for the 1st year classes, we had information of students about the interesting in continuing with the practice of workshops (Figure 1) and the perception of them to relate the subjects of the workshops as supporting the courses' subjects (Figure 2).

There were students interested to continue practicing and learning what the Educational Robotics insertion project provides; proving the first connections between the workshops content and the exposed content in the subjects, even when this did not occurred effectively. The actions presented in the workshops in 2014, even without the presence of huge interdisciplinary projects, using only quotes, examples, presentation of robots, besides mechanical and electronic components, allowed us to observe the project's potential.

In the context of the classes, the student reports brought a new view about the interest of the participants, enabling the project to attempt to reinvent itself in its practice. One of the students reported that using a programming tool in blocks, Scratch, allowed something new and simplified learning programming because it shows a fast visual result. As with P-CUBE that allowed a wide range of users to learn programming in an easy and fun way. (Motoyoshi *et al*., 2015) There was a better perception and greater understanding of robotics themes with Arduino, because the students could relate the subject with the Computer Architecture course. The simple action of showing electronic components in physical form contributed to the understanding of their functionalities. For better interaction with the practices of robotics and encouraging the pursuit for knowledge, an internal competition was organized, the Arena Robots. The Arena Robots was composed by Workshops preparation and competition. From this practice, there were students interested in developing a project for the Robotics National Exhibition (MNR). Then, it was built a mobile robot, vehicle style, which uses sunlight to recharge your batteries and it is controlled with a radio or TV remote control. Part of the project was made with reuse materials (Figure 3).

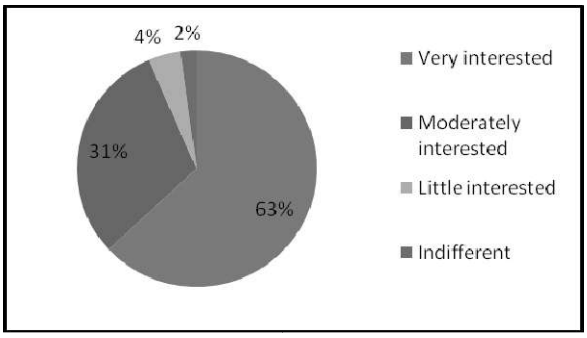


**Figure 1. Level of interesting of students from 1st year IT to continue learning Robotics. (2014)**

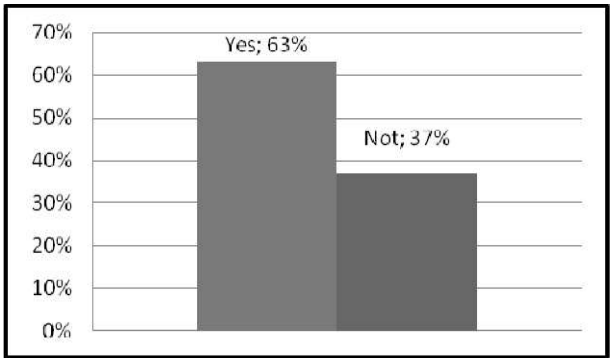


**Figure 2. Perception of 1st year IT students in a association between the workshop content and studied content in the course subjects. (2014)**

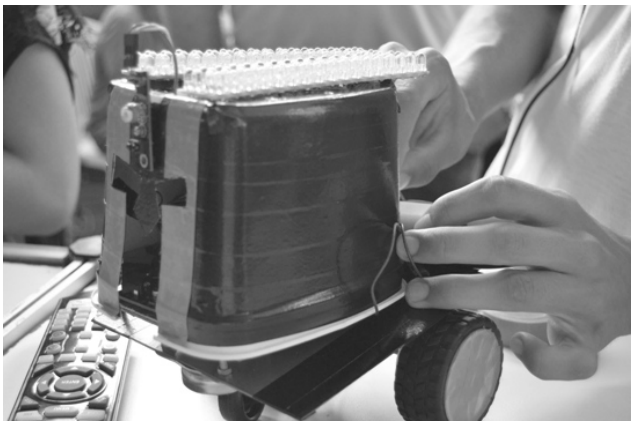

**Figure 3. Mobile Robot for the Robotics National Exhibition. (2015)**

The MNR project reached the expected results and the majority of them because of the knowledge gained from the attempt to produce the robot for the competition.

**Conclusion**

It was noticed that the Robotics is a subject of interesting to students, and it is believed that its use in public education contributed to the activities of the Territorial Center of North Coast Professional Education and Bahian Agreste (CETEP / LN) in Alagoinhas – Bahia, Brazil; Once it can promote the inclusion of active learning procedures, with a view to technological developments aligning them to the teaching methods adopted at schools, and promoting interdisciplinary as a way of knowledge fixing. We verified that by allowing public school students to contribute to the actual construction of knowledge and gain learning themes aligned to the resources that are already disseminated by the school, this practice encourages them to produce and participate in scientific events; furthermore, it involves their knowledge and life experiences. Consequently, it is intended to realize by the end of the project the social and educational transformation through the interaction with technology and its development by the interdisciplinary actions. Therefore, this work can provide a critical and constructive reflection of the knowledge, directing new research branches with free robotics through the involvement in scientific events where the practice of the robotics' development technology also promotes educational social development.

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