L.Y.R.A. – Laboratory of Inquiring in Robotics and Astronautics

Rui Manoel de Bastos Vieira[1], Emerson Izidoro dos Santos[1], Luís Paulo de Carvalho Piassi[2]

[1] Universidade Federal de São Paulo, R. Sena Madureira, 1500 - Vila Clementino, São Paulo – SP – Brazil

[2] Universidade de São Paulo, Av. Arlindo Bettio, 1000 – Ermelino Matarazzo – São Paulo – SP – Brazil – 03828-000.

Abstract

In this work we present preliminary results of the L.Y.R.A. project – Laboratory of Inquiring in Robotics and Astronautics – a proposal that develops playful production interventions of robotic toys with low-cost materials and easy access. The interventions were focussed in the natural sciences, but also articulated with the arts and the Humanities by producing handmade toys by participants and discussions of STS themes.. We seek to investigate whether the proposal has stimulated the interest of students for the debate and for the production of these artifacts. The name L.Y.R.A. is a reference to the brazilian Jackie Lyra, Mechanical NASA's aerospace engineer.

Keywords: Non-formal education; Robotics; Astronautics; Vygostsky; STS.

Corresponding author e-mail address: rui.vieira@unifesp.br

Introduction

Robotics and Astronautics have been widespread and excelled in recent years mainly by your insertion in different sectors of human life. They are related with themes ranging from fantasy in literature and in film until the real applications such as the development of toys, robots used in industry handlers, robots sent to space exploration, among others. However, in Brazil, this topic is still little present in reality.

In view of the need to promote the debate on scientific, technological and social issues of the 21st century have developed the L.Y.R.A. project with the goal of conducting non-formal interventions in the school environment, with students in their early teens, to discuss STS (Science, Technology and Society) relations. In the same way that Vieira, Tenreiro-Vieira and Martins (2011) we believe it is necessary to promote the development of skills that enable students to cope with the social, cultural and scientific context. In this sense, we investigate how to address themes of Astronautics and discuss concepts of technology and robotics from problem situations, proposed by our team, in which participants discuss about the issues in STS perspective and realize the production and manipulation of simple and programmable robotic toys.

In the following sections we seek to contextualize our work through a bibliographical revision indicating the relevance of the theme as well as the methodology adopted in the speeches. Also we present preliminary results obtained through an initial design of a methodology for data collection and analysis.

Problematics

In daily life, students can have access to numerous materials such as picture books, magazines, television reports, animations, comics, films, among others, that refer to the contents of Robotics and Astronautics and that are not part of the traditional topics of science of basic education. Eguchi (2013) emphasizes that in recent years the interest in robotics increased "tremendously" and defends the importance of the study of this topic in the training of students to work in an increasingly technological society. Also realize that access to artifacts such as robotic toys, educational kits and simple has become increasingly accessible both to your offer as at acquisition cost. Aroca (2012) highlights the existence of several proposals for educational robotic kits valued approximately $10.00 and develops a programmable educational kit for about us $15.00 to the brazilian reality. Blikstein (2013) advocates the use of robotics and new technology in education, pointing from an extensive literature review, the various practical applications of this theme in basic education and contributions to the training of students, such as fostering critical thinking, problem solving, creativity, teamwork and communication skills.

However, we agree with Alimisis (2013) when warning that the use of most of the technologies present in the schools-including the Robotics-in many cases reinforces the old ways of teaching and learning since the proposals generally are rigorously architected itineraries, which can become demotivating and have little relation with cultural context. That way, we're looking for in our work to present the preliminary results of our research into the development and implementation of recreational interventions with children between 11 and 13 years old, through the production of artifacts/robotic toys with low-cost materials and easy access and which allowed discuss STS themes present in the daily life of the students.

We understand that the Robotics and the Astronautics appear in mass media more complex both in physical architecture of robots as in the function they perform socially when compared to artifacts that can be produced during the proposed interventions with reduced cost and materials found in everyday life. In this sense, one of the challenges of this investigation was to promote strategies that take advantage of the interest of students by subjects of mass media and keep a good motivational level during the intervention. In the case of space exploration, for example, it is common to find reports commenting on the space travel conducted by probes or robots and how information obtained help researchers get to know a little more about the universe. Often, the speculation of what to be discovered is the most stimulating, questions like what will be the color of Pluto? Does Mars has water or some form of life? It is possible for humans to inhabit Mars? We understand that the playful and fictional component present in these mass media products and that arouses the interest of people on topics related to science cannot be subtracted from a didactic intervention proposal. In the next section we present a summary of the methodology developed by the research group.

Students Intervention Methodology

In our proposal, the playful and fictional component is the key element, is the engine that helps keep the learner motivated to know and learn. More than providing the possibility of interaction around a conceptual content, which is undoubtedly important, the activity must also establish an immediate bond of affective nature in relation to that knowledge. In this sense, our educational interventions begin with the proposition of problem situations that involve the use of science fiction in conjunction with the construction of robotic artifacts. We chose to develop the robotic artifacts from easily accessible materials and low cost as the Arduino platform/Gale and other items commonly present in the daily life of the student, as toys, old computers components, pet bottles, scrap metal, cardboard etc. We have found that the use of these materials in addition to supply the deficiency of professional robotics kits, which have a high cost for the reality of the vast majority of Brazilian schools becomes an educational instrument, helping to understand that several appliances work because there is a physical principle and engineering behind it, and not because they are products belonging to a specific industrial kit (Silva and Vieira, 2016).

However, in our view, only access to materials is not enough to establish an effective action of scientific concepts. We consider it important that the activities are guided by socio-historical theory of Vygotsky. From Vigotskian perspective, we think it is possible to consider that one of the roles of the experimental activities based on playful materials accessible is to collaborate to put problem situations situated in zone of proximal development – ZPD - (Vygotsky, 1986). When the problem situation is well established provides that all participants discuss the same ideas and attempt to reply to the same situation, an essential condition for social interactions occur properly (Werstch, 1984). From debates and experimental manipulation, with the survey and hypothesis testing, promotes the disinhibition of participants and consequently a richer social interaction, and generally asymmetrical in that the students discuss the results with their peers and the teacher/ L.Y.R.A. team (Ivic, 1989). This process of continuous asymmetric interaction allows you to check if the activity is appropriate for the student, according to ZDP (Vygotsky, 2001, p. 336) "[...] Teach a child what she's not capable of learning is as barren as teach her to do what she's been alone. " In this way, it is desirable that the problem situation has a difficulty level that the student can solve it through the use of a more capable partner and so can occur the cognitive development of the children.

An example of didactic intervention based on socio-historical theory that articulates science fiction with the production of robotic artifacts is related to exploration of the planet Mars. The intervention begins with a problem situation that encourages students to use information of mass media products, such as news magazines, movies, video games and others. In this sense, the problem situation can be around what you need to accomplish to establish human colonies on Mars. From this challenge, students need to imagine what it takes to get to this planet and how it is: surface, atmosphere, if there is some way of life and how our intervention would be in it. One possible way forward for this debate with the students would be to use the exploration missions of the NASA space agency, in which robotic probes were sent to the planet Mars. After this fictional situation extrapolation problem, are developed strategies for your solution, involving the construction of robotic artifacts and experiences of thought. The whole process is directed by L.Y.R.A. team members to assist students in their activities with the aim of adapting the challenge and the possible solutions to your ZDP. Discussions are held about the materials to be adopted as well as which artifacts are to be produced and their limitations. In the case of the choice of the construction of a stroller Explorer of the surface of Mars, for example, you can discuss what is required so that the vehicle can walk on the surface of the planet, if he should have four wheel drive, if you need to move from a previously installed on your system, since it would not be possible to program it in place to be explored, what kind of sensors would be interesting to make this offset in the surface, among others. The starting point occurs through the study and adaptation of models already developed by the L.Y.R.A. Group and/or models published on the internet, such as videos of Youtube channels dedicated to construction of objects in perspective do it yourself (DIY), among others. After this step, the materials are selected and is carried out the construction of the robotic artifact by students with the help of the team. We consider it essential that the tasks are neither too simple to point the student to solve easily and not very complex, making it impossible for your solution.

Below, in Figure 1, we present an example of a model developed by the project team, which consists of a programmable cart made with paper folding, electronic scrap and Genuine platform.

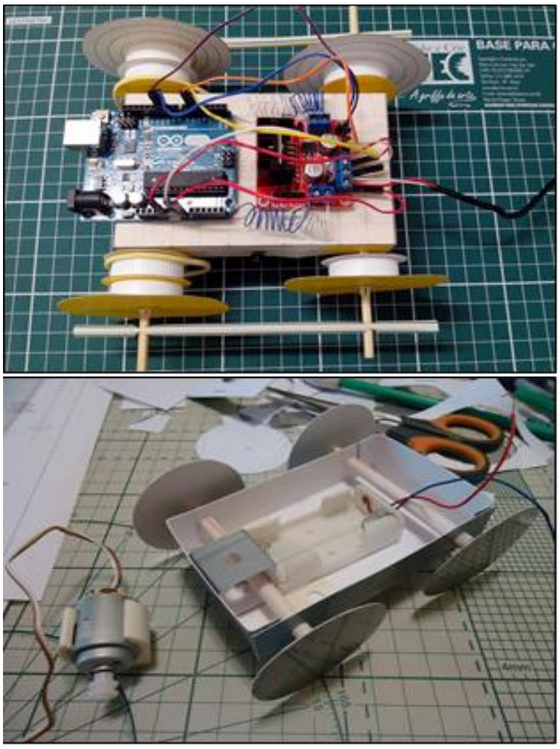

Figure 1. Programmable cart built through paper folding, with low-cost materials and Genuino. (source: author)

Data Collection Methodology and Analysis

The L.Y.R.A. project is coordinated by teachers of two Brazilian universities with graduate students who draw up the interventions to be carried out in the school environment with the aid of undergraduates. Interventions are implemented in schools by undergraduate students under the supervision of the teachers of the schools. In this paper, we will examine the data of the interventions carried out with children between 11 and 13 years old of public school elementary - E.M.E.F. Architect Luís Saia, São Paulo, BR. The school participates in a program of the Brazilian Federal Government to expand school day – Full-time School – have gradually gain space in Brazil and represents a new demand for schools through extracurricular activities.

In the course of the interventions we were interested in investigating if the introduction of activities at the school, when compiled from the parameters set out in the previous section, were able to stimulate the interest of students for the debate and for the production of artifacts. In our view, this is a fundamental requirement for the success of this type of activity and our proposal, and was the object of research to be explored in this paper.

For this, it was necessary to have objective data to record the interactions between participants and activities that point clearly to the achievement (or not) of the intentions laid down in research. Empirically, the data collection involved four sources: (1) fixed camera footage attached to audio recorders; (2) photographic sequences; (3) guided note-taking; (4) productions of the students. With these data, the first step in the processing of data was the temporal reconstruction of narrative intervention: what occurred at each moment, in which sequences, what actions, what agents and which results.

The footage provided a general plan and access to lines, the photographs captured the details of actions and digitally record your time. The notes were driven by what we call verifiable events, verbal and non-verbal cues recorded by means of selective observation of the behavior of the participants, from dynamic list of claims previously designed, according to Table 1. The items listed in this table correspond to hypothetical results are observed in the interactions between the participants and were designed as an initial parameter. During interventions new items were created dynamically and were later revised to evaluate hypotheses of interest. The approach was essentially qualitative, although the demonstrations could be held in quantities of occurrences and of which and how many students came forward.

Students
Demonstrate explicit and spontaneous interest in the topics under discussion.
Discuss topics proposed spontaneously after stimulated.
Propose issues not covered contexts, but of interest.
Establish relations with situations experienced in other environments.
Express interpretations and associations that stimulate the debate of ideas.
Take clear positions in discussions of social, political, ethical or moral.

Table 1. Example of list of verifiable events:
actions refer to knowledge (knowledge, skills and attitudes) assumptions in the didactic formulation process.

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The analysis of the data from this study was focused on the discursive manifestations oral, written and produced by students, although we have also considered the non-verbal language. During the implementation of the activity a undergraduate student was responsible for registering the dialogues among the participants. For the analysis of data we have adopted the work performed by Maingueneau (2006), linguist and professor at the University of Paris-Sorbonne, which considers the genre as social activities that are the success criteria.

Preliminary Results

In this section we present preliminary results of realization of the project in partnership with the Escola Municipal de Ensino Fundamental Architect Luís Saia, public school of São Paulo – Brazil. The activities were held with approximately of 30 students, between 11 and 13 years old, divided into three classes and always accompanied by teachers at the school. The project took place during 2015 in weekly meetings with a duration of 45 minutes, within the program more education, federal government initiative that aims to increase the permanence of children in school with extracurricular activities. Membership in participating in the project was voluntary, both for the school students and the teachers.

A total of 18 interventions were carried out with the kids, with the direct performance of undergraduate students under the supervision of graduate students and teachers of basic education. From a scientific initiation (Silva and Vieira, 2016) were identified 146 verifiable events, presented in table 2. We decided, in this work, for pointing out the occurrences of the events during interventions, regardless of the number of students who have manifested itself. In future work, we plan to drill down the data. In this sense, each instance refers to the manifestation of one or more students during an interactive episode. The interactive episode fits the specific moments, and distinguished among themselves, in which they promoted the interactions between partners of different capacities, by means of questions, propositions, discussions, materials handling, among others.

Manifestations observed		Number of events	Comparative distribution
A	Students demonstrate interest in the subject or the proposed activity	36	25%
B	Students dialogue with mediators and colleagues on the subject	34	23%
C	Students like and have affection for the materials used experimental	27	18%
D	They go beyond the issue addressed in other contexts	23	16%
E	They demonstrate difficulty with the subject or the proposed issue	12	8%
F	They demonstrate greater affinity with the theme of previous contact with the subject out of school	8	5%
G	They apply the knowledge gained outside the school environment	6	4%

Table 2. Distribution of the main manifestations observed in interventions with students of basic education (Silva and Vieira, 2016)

The analysis of verifiable events, from the items A and B, identified that most interventions aroused the interest of students who participated in the debates with spontaneous questions and answers relevant to the context of the established topics. In an activity on actuators and robotic hands, for example, discussed the different settings and different formats hands according to their purpose. Were initially used animals discussing how the shape of your feet, hands, hooves etc suited to the environment and your requirements, and to what extent it was necessary or not to have the finger opponent to hold objects. Then a discussion in the same way was made for mechanical and robotic hands of industry, medicine, etc. In this process the students participated actively citing and debating examples such as: the locomotion of some animals - lizard on walls; The grasping of objects - the tentacle with suction cups of the squid and the octopus, the feet of the birds in branches; Robotic artifacts in science fiction films - Iron Man, I Robot; Robotic arms in the automotive industry - holding and welding parts of cars, among others.

The item C showed that using simple materials of everyday life of students contributed to motivate them to participate in the activities, especially when proposed construction or handling of artifacts or toys. The examples of robotic artifacts used in the interventions conveyed the feeling that could be played by the students themselves. We believe that this element contributed to the entry and stay of the students in the project, as indicated in the speech of one of the children, "When I saw the robot that you did I thought, Wow, I need to do one of those".

We understand that the choice to use this type of material and the themes adopted also promoted the involvement of some students by extrapolating the actions proposed by the team. In item (G) we note that these students, on their own initiative, sought means to acquire components and materials for the construction of similar projects developed in interventions such as motors taken from cell phones, parts unused or broken toys, among others. After the acquisition of components the project team was requested to assist in the construction of students ' artifacts detailing the functioning of some components and how they could be adapted. From these data, we believe that our actions have significantly contributed to raising the interest of students for these subjects of natural science. As expected, we noticed that the students haven't had full autonomy for the more complex projects that required the insertion of programmable cards, as Arduino, however, managed to carry out the

Assembly of artifacts that required the design of straps, wheels, simple circuits involving motors, power supplies, switches, among others.

The difficulty presented by the students in item E was evident in the conduct of assemblies and programming of some artifacts. We consider this difficulty desirable since it does not prevent the student from performing the activity. In our case, we take care to propose challenges that students were able to solve through the help of more capable partners, the undergraduates. We verified the feasibility of adapting the challenge to the students' ZDI through the interactions promoted in their resolution. It was imperative to see if the student's actions were directed toward solving the challenge and whether they were potentially effective. If that doesn't happen, the challenge was discussed again from these actions and the reasons they were suited to the problem. Among the most evident steps were the construction of the artifacts and the development of algorithms so that the cart of Figure 1, for example, could deflect obstacles. In this process, the steps of construction, the use of tools, the code developed, among others were evaluated and discussed with the students until they reach a solution to the problem.

Conclusion

In this work we present the project L.Y.R.A. and the partial results of playfull interventions based on socio-historical theory of Vygotsky with a teenagers of the brazilian public school. The interventions promoted the debate on topics of Robotics and Astronautics and artisanal production of robotic toys with low-cost materials and easy access. We seek in our investigation to verify that the proposed methodology promoted asymmetric social interactions and if it was able to stimulate the interest of students by debate and to produce robotic artifacts.

In our view, the results showed that the topics discussed and the proposed methodology were satisfactory. Discussions around the themes of Robotics and Astronautics motivated students to exhibit their opinions about the use of technology in everyday life. The production of artifacts was the step in which the students have shown greater difficulty in effecting, in particular in the handling of materials. However, we note that although the students perform the production simple robotic artifacts – when compared to industrial models or present in the imagination of the students-they corresponded to expectations, becoming a motivating element of students. Even without our request, some brought to the workshops various motors and toys used, seeking to understand your operation and how they could be used in the project, giving rise to a new verifiable event (G).

We believe that the actions recorded in the verifiable event (G) showed that the project was more effective in encouraging students to theme and for the production of artifacts. These students have chosen voluntarily by dedicate part of your free time searching for materials and information that could be used inside and outside of project interventions. In future works, we intend to develop mechanisms that allow to identify more precisely the factors that promoted the students to continue the activities developed in a vague time.

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