The use of Robotics in Mathematics and Physics: teaching methodology and meaningful learning in Youth and Adult Distance Education (EJA EaD)

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2.1.1 - Innovative Experience (EI): Case Study

2.1.2 - Educational Sector: Secondary and Professional Technological Education

2.1.3. - Classification of Research Areas in EAD *(Zawacki-Richter 2009): Medium Level - Management, Organization and Technology: Educational Technology*

2.1.4. – Research Nature: Ongoing Project Description

Abstract

This paper aims to socialize a different methodology, with the use of robotics in the teaching of Mathematics and Physics for high school students in the Youth and Adult Distance Education in the SESI educational institution - Industry Social Service. Dealing with today's situations to adapt and expand knowledge, create resolution strategies, act and produce in teamwork, interact with people and make suggestions in challenging situations are characteristics needed by all, at all times, inside and outside school, in the workplace as well as in personal life.

Keywords: Robotics; distance learning; methodology and meaningful learning.

Introduction

Currently it is common to hear from educators reviews of the difficulties encountered in the teaching of Mathematics and Physics for students of the Youth and Adult Education (EJA). Which methodology should be used? What is the starting point for acquiring new knowledge? Which is the optimal approach to reach the experiences of students? From these questions, teachers and pedagogical teams discuss what subsidies should be used to improve the quality of learning and to improve understanding on how each student learns. The vast majority of students enrolled in EJA at SESI consists of industry employees who already have life experiences, social experiences, control their own lives and write their stories; they have a vast knowledge on machinery and equipment within industry, on interpersonal relationships and on their attitudes towards social problems and successes. Hence for these students to be able to learn and apply knowledge it is necessary for the teacher to use appropriate and assertive strategies, to allow the students to establish relations and meanings with their knowledge. As an example: the use of robotics in the classroom of Mathematics and Physics, setting aside the old "blackboard" and voice model, reinforces interaction with students and becomes a distinctive methodology.

Generally, students have an image that learning in mathematics occurs in the accumulation of forms and algorithms and in the adherence to follow and apply rules. Currently, this educational model has been questioned. What, then, would be the current model of teaching and learning mathematics? Does it happen exclusively in the use of blackboard and chalk? Today in the Youth and Adult Education these strategies should be reconsidered and replaced with regard to teaching and learning of workers who seek the meaning of what is being proposed to them and what they study at school.

> Many teachers consider the assumption of functions an undue burden other than pedagogical, meaning even an exploitation of their work. However, it is the faculty's duty to formulate policies arising from the socially sanctioned educational guidelines, to list the priorities of the systems and schools, to co-define the allocation criteria and allocation of resources, to identify the basic inputs for the development of excellence in educational work, to restore the dignity and status of the profession. (Gadotti, 2008: 77)

The number of students between 18 and 50 years enrolled in adult distance education at SESI is extensive, they are already in the labor market and realize the need to study, and they respect rules and agreements and are active and inquisitive. The difference between the ages in classrooms is not a harmful for student learning. On the contrary, with varied knowledge and experience they help each other, study together, exchange ideas, and therefore they learn.

1. SESI's role in youth and adult education in Brazil

SESI is a nonprofit private law entity under civil law; its role is to provide social services mainly to industry workers. SESI's Regional Department of Santa Catarina is one of 27 regional offices associated to National SESI Department (SESI/DN), with jurisdiction in the respective state territorial basis. It has technical and financial and administrative autonomy. SESI was created by the National Confederation of Industry (CNI) in 1946, according to the Decree-Law No. 9403 of the same year. The SESI Regional Department of Santa Catarina has officially started its activities on 6 December, 1951. It provides social services to industries in order to deliver better quality of life for its employees supporting the development of the state.

The field of Education provides access to knowledge and promotes the development of personal, social, cognitive and productive skills for children, youth and adults, so that the industry and the citizens grow steadily. It offers Youth and Adult Education services, continuing education and basic education, with emphasis on the Education of Young Children.

SESI's Youth and Adult distance education promotes an increase in basic education in the industry, aiming at young workers and adults who have not completed their education at the recommended age. The methodology is appropriate to the needs of the worker and the company, with flexible schedule and classrooms in the workplace or in local units of SESI.

The Distance Learning provides for constant interaction between students, technologies and information, and there is no reason to replicate what could be accomplished in a conventional classroom. The use of the internet

allows for: update, storage, retrieval, distribution and instantaneous sharing of information; overcoming of limits of time and space; construction of knowledge, collaborative and cooperative learning; autonomy of the students in the learning process, continuous and formative assessment process; high degree of interactivity; use of synchronous and asynchronous communication; decision making, increased awareness and expansion of social consciousness.

Considering the technology, mediator instruments for production and development of knowledge, the Youth and Adult Education at SESI includes in its educational process the access to the virtual learning environment (VLE) called SESIEduca. The VLE is the virtual classroom environment. In this environment, teachers and students have at their disposal a number of interaction and communication tools. Each course is under the responsibility of a teacher, and students attend an in campus classroom unit equipped with the necessary technological equipment to access the system (VLE) and receive the support and mediation of a Teacher along the term of the course.

2. **Learning Methodologies**

The methodology is assumed as a set of methods and techniques or teaching and learning strategies, which contains in itself a mutual policy that corresponds to the intended objectives.
However Masetto (2003, p.88) provides:

> Strategy and technique is not the same thing, the author states that the strategy is a broader term than technique. The strategy is a means to decide on a set of provisions, in other words they are the means that teachers use to facilitate student learning. Technique is material means and resources that are related to instruments used to achieve certain goals.

Basic education is one of the pillars of the learning process. Thus whence successful, it promotes the nurturing of quality of education undertaken in the early stages. It is an indispensable factor to achieve the minimum levels required for the process of social inclusion.

In the teaching of Mathematics, problem solving is part of a methodology that has been discussed over the past few years. Traditionally, the problems have not played their true role in teaching because, at best, they are only used as a means of applying knowledge previously acquired by

students. The most common practice is to teach a concept, procedure or technique and then present a problem to assess whether students are able to use what was taught.

In youth and adult education, the methodology used by teachers has to embrace different techniques that must regard the various levels of knowledge, different experiences of adult learners in heterogeneous areas and the meaning of this context. Students have an established concept of mathematics as a subject that learning occurs by the accumulation of forms and algorithms. They think that learning mathematics is to follow and apply rules in solving exercises addressed to them. The methodologies used by teachers working in Youth and Adult Education at SESI help the student to interact with the knowledge and, as a Distance Education program (EaD), it uses the 25% system of regular in-unit (classroom) classes and 75% distance classes, thus going beyond the physical environment of the classroom.

Students attend the school environment twice a week, a period that suits better their working hours. In these moments attending the classroom, representing 25% of the whole, contents studied are accompanied by explanations of a Teacher. In the other 75%, the student attends a virtual environment called SESIEduca (virtual learning platform) participating in activities such as forums, preparation of collaborative text, *online assessments,* review activities, text reading, content reinforcement videos, receiving and sending messages *via e-mail,* visit the library, calendar, bulletin board, among other interactions.

For students who do not have internet access at home or in the company where they work, the school has a computer room for organization of school activities and access to the virtual environment; and Teachers perform the formal training of new students and students with difficulties in the IT area for the use of the virtual environment SESI Educa.

When asked about the use of the methodology, the students of Youth and Adult Education at SESI reveal their satisfaction. As stated by the student Darlan Vogt "it is very cool to have different learning methodologies, such as LEGO, we learn in theory and practice without even realizing it."

As we know, in fact it is necessary that all the content taught (in a pleasant way) is accompanied by interesting and creative activities that take

students to develop the skills needed to relate learning to the work field and personal daily life, as Jose Carlos Libâneo (1999, p.22) said:

> (...) Responsibility, initiative, flexibility of changing roles, rapid adaptation to machinery, tools and work techniques involving interdisciplinary teams (...). Development of cognitive and operational capabilities, progressing to an independent, critical and creative thinking (...)

2.1 - Robotics: From History to the classroom

The objective of this study is to demonstrate how robotics is held at the Youth and Adult Distance Education Learning program at SESI, in the subjects of mathematics and physics. The area of robotics has become quite popular in recent years, especially in education, where it is possible to use teaching tools and learning through theory, practice and recreation. LEGO bricks are used to develop the robotics within the Youth and Adult Education Distance Learning program at SESI. The LEGO Education Technology Program is composed of resources that aim to support and enrich the teaching and learning:

- LEGO Education kits: comprised of different blocks, gears, connectors, beams, engines and programmable blocks.
- Student’s notebooks
- Educator's Handbook
- Assembling Handbook

For the use of materials which remain in the Operative Unit by Teachers there is an yearly training and qualification program. The potential of using LEGO material begins to be applied and distributed along the program courses. The application of this educational technology meets the objective of allowing the industry worker student, enrolled in the various subjects, to develop talents for teamwork.

Classes in which the LEGO material is used occur in classroom meetings of the subject course where the content and assembly are integrated. Therefore, during the course, the Teacher performs at least one class with LEGO, where most relevant, and within the availability of the *kits* in the Regional Unit. In this context, contents are selected for each course in the teaching material of SESI EJA (printed and in the VLE) and, for each content, a

specific context was created. Also, skills to be worked on were identified in the matrix of skills.

The teacher plays a vital and indispensable role in the successful implementation of our program in the classroom. Its role is to help the student to think, to provoke their curiosity and encourage research, thus the young and adult become protagonists of their learning in a spirited and friendly atmosphere. The teacher also plays the role of mediator, urging students to reflect on different ways of solving a particular challenge. The teacher has to prepare students to be able to create new technologies and seek innovative solutions using the technological concepts learned in a rational and efficient manner. LEGO came to develop the use of robotics and bring a different methodology to work with Mathematics and Physics. In order to apply robotics in the classroom first of all it is necessary to contextualize content in the Virtual Learning Environment (VLE) through the SESIEduca. Students access the environment, they read the document and come to the classroom with the basic knowledge on the subject. In class, the teacher plans how to work with the pieces of LEGO and what shall be assembled. According to what will be assembled with the parts, the teacher has to work with the mathematical concepts just afterwards. For the application of this methodology there has to be the four Cs: Contextualize, Construct, Contemplate/Analyze and Continue.

Students form groups of four, where each student has a role to carry out the proposed activities. The **Organizer** is responsible for the overall organization, including the *kit.* He will also coordinate the selection of pieces (in conjunction with the constructor) and the disassembling of the project, to properly store all parts. The **Constructor** is responsible for coordinating the assembly, so that all members can participate in activities. The **Programmer** is responsible for the preparation of programming and the automation of assembly. Therefore, the use of the computer is required. The **Presenter and leader** makes the registration processes and the activity results and is responsible for the presentation of the results and the team opinion about the project.

FINAL REMARKS

The subject of mathematics has been pointed out, over time, as the main responsible for school failure. The purpose of this paper was to show a more interesting and enjoyable proposal to arouse both the interest and the reasoning of students in mathematics classes in the Youth and Adult Distance Learning Education program, which is the Robotics developed with LEGO pieces. This proposal allows students to develop and exercise their motor skills, exploring technological concepts through creativity and logical thinking, and allowing the construction of various projects integrated into the content of each class. Robotics presents the world of science and technology to young people and adults in a relaxed yet committed approach, in addition to expanding the interdisciplinary knowledge, essential to develop critical thinking and forming opinions about global issues, for example, social, political, economic, education and health actions. The focus on studying and learning is a priority for those who want to enter into higher education, continuing education courses, specializations, etc.

This pedagogical methodology used by the teacher leads the student to identify and understand concepts, raise hypotheses and compare them with the assumptions of colleagues, validating or modifying their own idea, while respecting and valuing other people's opinion. These are important conditions for the development of skills, the qualification and construction of the citizen. Robotics is currently in a constant and rapid evolution. Situations in the not too distant past were considered work of fiction and are now reality, thanks to the advancement of research in areas such as electronics, mechanics, computer science and Artificial Intelligence.

SESI Educa: To access the Virtual Classroom Environment visit the website www.sesi.org.br/sesieduca

SESIEduca is the virtual learning environment that offers tools for interaction, cooperation, evaluation and communication. The student can access it from any computer that runs the internet, with a personal password and login received at registration.

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