

# Chapter 215

## Pedagogical proposal for the insertion of an “accessible maker culture” aiming at adapting state schools to the New High School

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### ABSTRACT

For years, the learning of Natural Sciences has been questioned, with experiments being considered as an excellent tool for students to establish the inseparable relationship between theory and practice. And aiming to increase the learning of Brazilian students, observing the low educational levels achieved in recent decades, the federal government proposes changing secondary education. Starting in 2022, in this new model, basic education is aligned with “Itinerários Formativos” to meet the principles of

human training integrated with youth protagonism. A “maker” culture is suggested, based on robotics, 3D printing, laser cutting machines, smartphones and Arduinos in the creation processes of these students, but the reality of Brazilian public schools is far from this conception. And that's why this work aims to disseminate a practical project carried out in a public school in the state of Rio de Janeiro based on a culture of Do It Yourself (DIY). Showing that the maker movement is indeed favored by technological advances, but the maker proposal is the student's protagonism, not being necessary, to remain, in this first year of implementation, only dependent on such advanced technologies.

**Keywords:** Public school, Maker, Accessible education.

### 1 INTRODUCTION

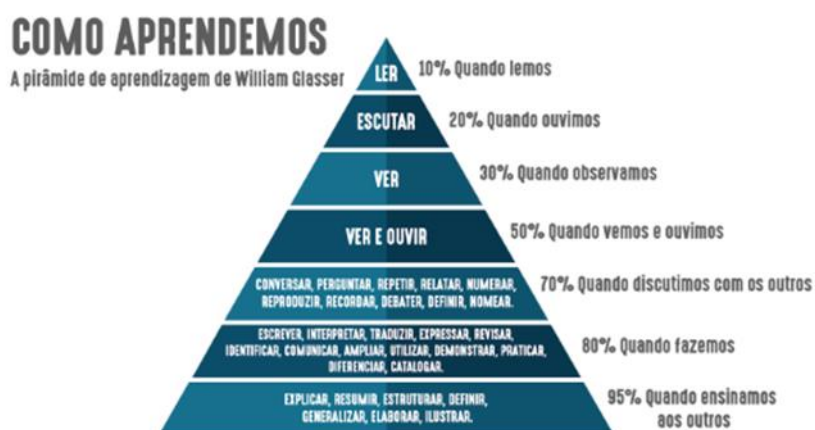
According to cognitive neuroscience, learning and memory are strongly related, with memory being the organic basis for learning to occur. Memorizing is not the same as learning, but for learning to occur, information must be stored in our memory. For Izquierdo “Memory is the process by which what is learned persists over time”. (GAZZANIGA, et. al., 2006) According to Gazzaniga and Heatherton:

“Current thinking argues that the way in which A teenager's thinking develops depends a lot on of the content of the problems that adolescents encounter and the contexts in which they find themselves.

Hence the importance of offering intervention activities. (GAZZANIGA, et al. al., 2005). The natural sciences, mainly chemistry, is a science that involves a lot of knowledge from other areas and has unique characteristics that always lead to the need, in the act of teaching, to make connections between different

points such as the concrete-abstract, the macroscopic-microscopic, the empirical-theoretical. (Passos, C.G.; Pino, J.C., 2017)

According to the psychiatrist William Glasser (1925-2013) the teacher is a guide for the student and not a boss. Glasser arranged the level of learning according to the technique used in a pyramid. According to the theory we learn: 10% when we read; 20% when we listen; 30% when we observe; 50% when we see and hear; 70% when we argue with others; 80% when we do it and 95% when we teach it to others, as shown in Figure 1. (SALES, et. al., 2019)



Source: <https://editoragp.com.br/piramide-de-aprendizagem-william-glasser/> Acesso: 23/12/22.

As life experiences can be similar, but never identical, and the “cultural environment” does not provide coherent directives, but presents conflicting, ambiguous and transitory messages, the process of “interiorization” is extremely complex. (PUSSETTI, C., 2015) As experimental activities play a particular role in the teaching and learning of Natural Sciences. (RECEPUT, 2020)

Attico Chassot, when questioning the usefulness of teaching Chemistry, proposes alternatives for this, and among them:

the one that seems to be gaining more supporters and has already managed to produce some concrete results is the link between Chemistry and daily life and the concern with the use of popular knowledge. It should be noted that these attempts to link teaching with situations closer to students still have a difficult time in high schools (CHASSOT, 2004)

In view of these notes and the low rates in the largest study on education in the world, the International Student Assessment Program (Pisa), which indicates that Brazil has low proficiency in Reading, Mathematics and Science, the Brazilian government included the renewal of High School among the strategies of the National Education Plan – PNE. (MEC, 2019. - Access: 12/22/22); (Student Guide, 2022. - Access: 12/29/22); (BRASIL, 2014).

Students who entered the 1st year of high school in 2022 found new features in the teaching modality that was previously offered. The implementation of the New Secondary School began, with the changes provided for in Federal Law No. 13,415/17. (BRASIL, 2017)

The change aims to guarantee the provision of quality education to all young Brazilians and to bring schools closer to the reality of today's students, considering the new demands and complexities of the world of work and life in society. This implementation defines a new curricular organization, more flexible, which contemplates a National Common Curricular Base (BNCC) and the offer of different possibilities of choices to the students, the training itineraries. (MEC, 2019. - Access: 12/29/22) (MEC- 2022. Access: 12/29/22)

The training itineraries are organized around four structural axes: Scientific research, Creative processes, Mediation and cultural intervention and Entrepreneurship. (MEC, 2018. - Access: 28/12/22) Faced with this new educational scenario, this work proposes to explore the “accessible maker” approach in the proposal of the Formative Itinerary of Creative Processes, Mediation and Cultural Intervention.

The Do It Yourself (DIY) culture brings the idea of reusing and/or repairing objects, rather than discarding and acquiring new ones. This project is based on the “accessible maker” or Do It Yourself (DIY), as it believes in access to knowledge by “hands-on”.

A maker culture based on technology and 3D printing is proposed, but this is not the reality of most Brazilian state schools. (SENADO AGENCY, 2022- Access: 12/20/22) But how to implement the “maker” culture in a school without internet access?

Thus, with the objective of increasing students' interest in Natural Science classes and aiming at the development, in students, of concepts related to Chemistry, the environment and skills and competences such as responsibility, planning, initiative and creativity. And with the aim of adapting classes to the New High School, a case of success carried out at Colégio Estadual André Maurois (CEAM), located in the State of Rio de Janeiro, is disclosed, a practical project based on DIY.

## **2 METHODOLOGY**

The target educational follow-up of the project was students of the 1st year of high school, aged between 14 and 18 years, from Colégio Estadual André Maurois, approximately 100 students were covered by this project.

The proposed theme was “waste reuse”. The teacher suggested that these students look at home for materials that would not be useful to them and reuse them by creating an object of their interest.

The classes were separated into groups and these were divided by materials: Glass, Plastic, Paper or cardboard, Metals and Non-Recyclables (such as fabrics and wood).

After the proposal given in the classroom, there was a brief conversation (50 minutes) between the teacher and the students, where the performance evaluation instruments were also explained: participation in the classroom, group presentations, finished products, reports and the criticisms elaborated on their own social realities.

### 3 DEVELOPMENT

Firstly, the students were divided into groups of 5 or 6 people and the themes were drawn, followed by an explanation of the activity and evaluation methods (products and reports).

The groups were asked to create an object from materials not used in their homes, according to the chosen theme. It was explained that the intention of the work would not be for them to pick up garbage or buy anything. And then a week was given to make the products from reuse of materials no longer used in their homes. The group that was going to present small objects (such as pencil holders, cell phone holders, among others) would have to present one piece per student and groups that were going to present larger objects (such as lamps, stools and shoe racks) could present one piece per group, provided that during the elaboration and presentation all the members participated.

Aiming to help them with a more elaborate research, there was a conversation about: What is garbage - presenting the definitions of waste and waste, what types of waste are usually found in everyday life (at home and at school) , selective collection, the logic of the 7 R's (Rethink, Refuse, Reduce, Reuse, Reuse, Recycle and Recover), the difference between reuse and recycling and the concept of sustainability.

The time given to the groups to make the objects through the reuse of waste was one week.

The resources needed were: Whiteboard, whiteboard pens, materials not used in the students' homes (paper, metal, glass, plastic, fabric, wood, paint) and research books.

The activity was evaluated according to three instruments: 1-Group presentation; 2- Quality of the manufactured product; 3- Report.

1- Presentation of group work: (Attitude of the group and of the individual student)

- Creativity, teamwork capacity, responsibility, initiative, planning and organization, synthesis capacity and manner of expression (without using informal language) were evaluated here.

At the end of the presentations, two questions were asked:

A- What do you observe in your homes in relation to garbage disposal? In none of the cases was there any separation of materials and in approximately 15% of the students it was reported that garbage was disposed of in ditches, due to laziness in walking to the proper place. – Here, speech, synthesis capacity, and critical and reflective posture about their realities were evaluated.

B- Based on the work done, what is the importance of studying Chemistry and Natural Sciences at school? The students who responded to this stimulus were able to relate a better understanding of Chemistry to a better quality of life. – Here the speech, the appropriation of Chemistry as a science and the critical and reflective posture about its realities were evaluated.

1- The quality of the products produced:

The groups presented their productions (shoe racks, lamps, pencil holders, cell phone holders, bookcases, wallets, purses, safes, jewelry holders, stools, flower arrangements, fruit holders, napkin

holders, dog houses, book bookmarks , remote control holder, ornaments, vegetable garden in pet bottles, among others), as shown in Figure 2, below:



Source: Author, 2022.

On the board, they explained which materials were no longer discarded in the trash, indicated the color of the trash can that their products should be discarded if there was no reuse done by themselves and the step by step of how the products were made - Creativity was evaluated here , the capacity for teamwork, curiosity, initiative, planning and organization.

#### 1- Report:

Assessment carried out through an individual report that needed to include: A- the report on what was done by the student in the preparation of the product presented, B- a research on the reuse and recycling of waste (definition and examples of the different materials), C - the comparison between the decomposition time of different materials (glass, plastic, metals, paper/cardboard) seen in the works presented in the classroom, D- Definition and importance of Selective Collection; E- Color of the bins for depositing waste of different materials (eg plastic-red), F- What types of environmental pollution can arise from depositing garbage in inappropriate places.

– Here, it was evaluated whether there was appropriation of the concepts: Waste of natural resources, characteristics and time of decomposition of different materials, reuse and recycling of garbage, selective collection, environmental pollution and sustainability.

#### 4 FINAL CONSIDERATIONS

From this proposal, the students commented that the school is no longer a space of silence, but open to dialogue and their own ideas, seeing the school as a democratic and more interesting place. This methodology aroused a greater interest in Chemistry classes on the part of the students, considering the characteristics of the works presented, thus, it is observed that the activities have collaborated for the achievement of the proposed objectives. And it is concluded that it is an interesting methodology for approaching topics such as the environment and chemistry in schools that aim to adapt to this proposal for a new high school through an alternative “accessible maker”, understanding the reality of public schools and students target. It is mentioned that schools must innovate technologically, and it is intended to integrate this project over the next few years to the possible technologies that reach the school, however, this “maker” culture should not be demoted due to the lack of these “greatest technologies” as impressions 3D, laser cutting machines, smartphones and Arduinos.

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