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INTERACTIVE EXPERIMENTS: PLAY AND LEARN SCIENCE

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ABSTRACT

This article presents an exploratory qualitative research, according to Trivinõs (1987). This is a case study, according to Gil (2008), applied in 2024, in a public school of basic education, in the municipality of Taquara, Rio Grande do Sul. The action addresses a Science workshop with interactive experiments, aimed at children in the 3rd year of Elementary School and created according to the Thematic Units for Science, in this school year, presented in the National Common Curriculum Base (BNCC, 2018). Three classes were attended, one in the morning and two in the afternoon, totaling 51 children in the age group of 8 and 9 years old. The main objective is to understand how interactive experiments can contribute to the learning of Science when the target audience is children. The action is part of a larger scientific dissemination project of the Federal Institute of Education, Science and Technology of Rio Grande do Sul, Rolante campus, applied collaboratively with public schools in the Vale do Paranhana region. To have a data collection instrument, the children were asked to make and deliver a drawing that represented what they learned from the workshop. The collected data were analyzed through Content Analysis, according to Bardin (2011). The results found are promising, this could be inferred through the three categories that emerged, a posteriori, being: (i) Meaningful learning; (ii) Learning built in the socio-historical context and (iii) Learning of scientific concepts. Although it is exploratory research, without a framework for generalization, in this case study the children bring us traces that interactive experiments help in the learning of Science, since they provided the construction of knowledge. In addition, the activity was well received and there was the engagement of all students in carrying out the experiments and in the proposed task, as well as the monitoring and assistance of the teachers of the classes.

Keywords: Interactive experiments. Science Teaching. Collaborative network.

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INTRODUCTION

It is undeniable that Science, for a long time, has been capable of producing new knowledge and providing a theoretical basis for the search for solutions to the problems of our daily lives. (AVILA ARAUJO, 2006). Proof of this occurred in the years 2020 and 2021, when all countries went through the pandemic period due to the spread of the coronavirus. The acute respiratory infection, called Covid-19, was responsible for the death of many people around the planet, and to prevent more lives from being lost, schools closed, students and teachers were isolated in their homes.

During this period, researchers worked intensively to create vaccines against the virus. According to Silva at. all (2023), to avoid further damage caused by the COVID-19 Pandemic[4] , there was mobilization and cooperation among scientists who research drugs to quickly and effectively obtain an immunizer that would allow the situation to be controlled. It is usually a consensus that, due to the numerous stages of vaccine development, in non-pandemic time, it takes about 10 years to mass-produce and apply a new vaccine, however, with the chaos caused by SARS-CoV-2, it was possible to manufacture an antiviral in 12 to 18 months.

This is just one example of the importance of Science in people's lives. If we were to enumerate the benefits brought by the development of scientific knowledge in society, the work would be prolonged. According to Albagli (1996), the practical results of scientific research were felt, in a more direct way, from the application of the knowledge built to create machines and equipment used in the Industrial Revolution, in the mid-seventeenth century.

In the current social context, we are all affected by scientific and technological changes, since Science and Technology (S&T) is more rooted in several sectors, mainly economic, political, and cultural. It is technology affecting the forms of production in industry, in the field,
in small rural properties, in the way we relate to people, the world of work and in schools.

Given the relevance of Science, it is of paramount importance that people have access to scientific knowledge to understand how it works, for example, the electronic devices they use and can understand the technical information in the manufacturers' instruction manuals. In addition, children as subjects in the process of formation need to be

[4] The disease is caused by the SARS-CoV-2 virus, which received this name due to its phylogenetic similarity with the severe acute respiratory syndrome coronavirus previously isolated.

gradually prepared to exercise their citizenship, or rather, that they are capable and able people to analyze situations, propose solutions, plan and execute tasks, undertake and seek solutions to local problems in adolescence and adult life. However, for this, children need to learn Science from the early years of Elementary School, with activities that respect the rhythm and more playful style of children's learning.

In this perspective, this workshop was created with the general objective: to understand how interactive experiments can contribute to the learning of Science when the target audience is children. The specific objectives are: scientific dissemination; to promote the learning of scientific concepts; stimulate research; valuing the school as a learning environment; stimulate the study of Science and strengthen the ties of cooperation between the Federal Institutes and public schools in the Paranhana Valley, Rio Grande do Sul.

It is a qualitative approach, which according to Trivinõs (1987) investigates events, seeking their meaning in the context. The qualitative methodology seeks to understand the essence, origin, relationships and changes of phenomena.

This investigation addresses a case study, defined by Yin (2005, p.32) as being: "an empirical investigation that investigates a contemporary phenomenon within its real-life context"

THEORETICAL FOUNDATION

According to Viecheneski and Carletto (2013), the methodology of Science teachers can both stimulate curiosity and investigative spirit in students, awakening enchantment with Science, and it can also numb and inhibit these feelings. Thus, liking or aversion to Science can affect the future professional choices of students. From this perspective, children's first contacts with Science need to be pleasant.

> [...] if it makes sense to children, they will like science and the probability of being good students in later years will be greater. On the contrary, if this teaching requires memorization of concepts beyond what is appropriate for this age group and is uncommitted to the student's reality, it will be very difficult to eliminate the aversion they will have for the Sciences. (CARVALHO et al., 2007, p.6)

In this sense, it is relevant to invest in the initial and continuing training of teachers so that they have moments of reflection to revisit their conceptions of Science teaching, as well as updating scientific knowledge, the options of differentiated didactic resources,

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including Information and Communication Technologies (ICTs), aiming at the elaboration of differentiated Science classes, capable of stimulating and capturing the interest of students. Because, according to Gouw, Mota and Bizzo (2016, p.643): "Interest in school science is one of the paths taken to reach academic science".

In this bias, the teaching of Science needs to be something engaging. One of the ways to involve the student is to provide him with the opportunity to observe and interact with experiments. According to Freire (1997), the construction of knowledge about the object through an experiment implies the exercise of curiosity, which is interconnected with the critical capacity to compare and formulate questions.

According to Millar (2014), in the teaching of Natural Sciences, it is important to learn by manipulating concrete materials, especially children who are still in the process of abstract thinking, because experimentation facilitates the observation of the causes and effects of the phenomena that occur in the subject/object interaction. In this way, spontaneous concepts can be understood by the child in a more friendly way.

According to Vygotsky (2008), there is a difference between spontaneous concepts and scientific concepts. The author states that the construction of spontaneous (or everyday) concepts occurs through the person's interaction with real objects and through experience with other people. It is a knowledge resulting from the observation of actions and reactions through events, or rather, spontaneous concepts are constructed as a result of lived and/or observed experiences.

As for scientific concepts, they are specific to the school environment, because they are built through systematized and mediated teaching. Scientific concepts are not possible to be created and internalized through personal experiences, and this differentiates them from spontaneous concepts.

> [...] We know that concepts form and develop under totally different internal and external conditions, depending on whether they originate from classroom learning or from the child's personal experience. [...] When we impart systematic knowledge to the child, we teach them many things that they cannot see or experience directly. (VYGOTSKY, 2008, p. 108).

However, for the author, spontaneous concepts also play an important role, because they will be the foundation for the construction of scientific concepts. It is the spontaneous concepts that are replaced by correlated scientific concepts when systematized teaching occurs, in this sense they are support. It is not possible to teach direct scientific concepts, even if the teacher tries to teach the result will be mere repetition, devoid of meaning and without connection to the student's real world. Vygostky (2008, p.104) states that "experience shows that the direct teaching of concept is impossible and fruitless*".*

From this perspective, teaching Science as a collection of themes, phenomena and the exhibition of scientific discoveries, without considering the context and the knowledge that students already bring with them, their experiences, even if rudimentary, is not coherent, because the result is ineffective. The formation of scientific concepts is more complex, because it involves a slow and gradual process, but it is possible to be followed in basic education when anchored in spontaneous concepts, as Vygotsky (2008, p.136) states: "[...] an everyday concept opens the way to a scientific concept and its downward development."

In this sense, the workshops presenting Science themes, with specific themes of Physics and Chemistry in Early Childhood Education and Elementary Education are pertinent, because they can be children's first contact with interactive scientific experiments. Initiation into the world of Science.

METHODOLOGY

The planning of the workshop was done according to the Thematic Units for Science, 3rd year of Elementary School, as presented in the BNCC (2018). Chart 1 provides information about the Thematic Unit, the target audience, the objects of knowledge, the skills to be developed, the guiding question, the experiments and, finally, registration and reflection.

Chart 1 – Workshop planning

WORKSHOP		
Thematic unit	Matter and energy	
Public	3rd year of Elementary School	
Objects of knowledge	Sound production; Effects of light on materials; Hearing and visual health	
Skills: (EF03CI01) Produce different sounds from the vibration of various objects and identify variables that influence this phenomenon. (EF03CI02) To experience and report what happens with the passage of light through transparent objects (glasses, glass windows, lenses, prisms, water, etc.), in contact with polished surfaces (mirrors) and in the intersection with opaque objects (walls, dishes, people and other objects of everyday use). (EF03CI03) Discuss habits necessary for the maintenance of hearing and visual health, considering the conditions of the environment in terms of sound and light.		
Problematizing issue	How can we create the sound?	
	Experiment 1	Sound oscillations - producing sound for various instruments (whistle, flute,

		harmonica, drum and rattles)
Interactive activities	Experiment 2	Corded telephone – transmitting sound waves over a wire
	Experiment 3	Glowing in the Dark – Interacting with Black (Ultraviolet) Light
Registration and reflection	Make a drawing that represents what you learned while performing the experiment(s). What do you think noise pollution is? Does it harm our ears?	

Source: prepared by the authors (2024)

After the preparation of the planning, the experiments were created by the project coordinator and scholarship holder (seeking the use of recyclable and/or low-cost materials), tested and separated into organizing boxes. For the application of the workshop, the work team agreed with the teachers and school management the date and time that the activity was carried out. It should be noted that a teacher from the school contacted the project coordinator (because she already knew about some of the activities carried out) and requested that the workshop be held at her workplace.

WORK TEAM

The work team is composed of a coordinator (Computer Science teacher), a collaborator (Physics teacher) and a scholarship holder (student of the Technical Course Integrated to High School, 2nd year). All members are part of the faculty and/or student body of the Federal Institute of Education, Science and Technology of Rio Grande do Sul, Rolante Campus, RS. The coordinator has a project registered in the Integrated System for the Management of Academic Activities (SIGAA), of the IFRS, entitled *Science is Trilegal.* This project includes 10 workshops, ranging from Early Childhood Education to all the Early Years and Final Years of Elementary School. The workshop presented in this article is an excerpt from the other activities developed by the work team and is justified because it was the most replicated so far.

SCHOOL CONTEXT

State, public school, which offers Elementary Education in the morning and afternoon shifts. It is located in the peripheral area of the city of Taquara, Rio Grande do Sul. The Workshop was applied to three classes of the 3rd year of Elementary School; one class in the morning shift with 19 students and two classes in the afternoon shift (one with 20 students and the other with 12 students), totaling 51 children in total, in the age group of 8 and 9 years old. It should be noted that the afternoon classes were gathered in a single room, with their respective full teachers, because there are few students in each class, so the teachers responsible for the children opted for integration.

WORKSHOP DEVELOPMENT

In the classroom, the work team introduced itself to the children and brought some explanations of what would be done on the day. A space was also opened for questions and the questions that appeared the most were: how is the Federal Institute where the executing team works; how students enter the institution; what is the age of the students and what courses they have at school.

After the initial conversation and resolved to the questions, the problematizing question was asked: how can we create sound? To this question the children were thoughtful and only a small number of children responded. Here are some answers: "*turning on the radio"; "playing a guitar"; "singing"; "stamping their feet on the ground".*

Then, it was said by the workshop teachers that we were going to do some experiments and explain how and why the phenomena they were going to observe occur. So, we started with experiment 1 – sound oscillations (producing sound with different materials).

For this, a harmonica, a whistle, a bamboo flute, six 'drums' (made with glass and a latex membrane) and six drumsticks (made with a barbecue stick and a styrofoam sphere), six rattles (made with two yogurt cups, adhesive tape and different internal materials, each rattle has different objects, such as: pebbles, grains of rice, grains of lentils, clips, sand and small screws.

The blowing on the whistle, harmonica and flute was done only by the workshop teacher, in order to avoid mouth-to-mouth contact, and thus prevent the contamination of viruses and bacteria in the children. The rattles and drums were distributed to the students organized in groups, it was asked that the children, all of them, interact with the musical 'instruments', or rather, play the drum with the drumstick and shake the rattle. The groups were also asked to change the rattles themselves and try to identify the rattle inside them (the rattles were identified by numbers 1, 2, 3, ..., 6.

The activity of shaking the rattles and identifying what was inside them was received as a very lively game, the children brought the 'instrument' closer to their ears and made an effort to identify the one inside and some wrote down in the notebook the object they thought was the hidden object. Then each rattle (rattle 1, rattle2, even rattle 6) and the objects inside them were written on the board. With each correct answer, the children vibrated with happiness.

The drum was also received with enthusiasm, the students made the membrane vibrate with the beat of the drumstick, this caused admiration because they did not know that with just a glass and balloon they could have a sound produced similar to a drum.

After carrying out the interactive experiments, the workshop teachers explained that sound is produced by a disturbance, citing the examples made, which is propagated (transmitted) through a material medium (in this case air), which is classified as a mechanical wave, it was also explained what a wave is and how the human ear is sensitized in the eardrum (which vibrates like the membrane of the drum), and it produces electrical impulses that reach the brain, which are decoded and identified. At this time, the risks of listening to sounds at high intensity have been talked about because they can damage the eardrum and cause hearing problems.

At the end of this stage, the students were asked to go to the schoolyard. At that moment it was explained that they would receive a corded phone, which they would use to talk to a colleague. Then, the pairs were formed, at the discretion of the students, and seven corded telephones (made with two Styrofoam and/or cardboard cups and a line serving to connect the cups) were distributed. The pairs used the corded phones and, after use, gave them to the work team so that other pairs could also use them. This was done until all the children had interacted with the experiment. Returning to the classroom, it was explained that the corded telephone transmits the sound wave produced during speech, and it was also revised that the sound wave is a mechanical wave that needs a material medium to propagate. In this case of experiment 2, the wire is the material through which the voice propagates.

Continuing, the last experiment (experiment 3) of the day was discussed, stressing that it would be different from the others, we would use an unusual lamp, an ultraviolet lamp, better known as black light. In the presence of ultraviolet light we can see some hidden things and it is this experiment that we would do at this moment.

So, the curtains were closed to make the room dark and we turned on an ultraviolet lamp that was under the teacher's desk. The children were seated in their previous locations, in groups, and were asked to move to the teacher's desk (all members of the group) and interact with the light. This activity aroused a lot of interest in knowing what would or would not become fluorescent when exposed to 'black' light. Thus, long smiles

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were given to show their teeth to their classmates (with a white/indigo hue), the nails were also kept exposed to black light to know if they were whitish or not, so they were also testing other materials, such as: colored hair elastics, tennis shoelaces, money bills for viewing the watermark, embossing, safety wire, microprints and fluorescent elements. Finally, the students experimented to find out what would 'glow' in the interaction of the object/ultraviolet light.

Next, the work team explained what ultraviolet light is, which is also a wave, but is different from the sound wave, because it is an electromagnetic wave. It is part of the visible electromagnetic spectrum (set of waves) and in fact we only see the part of purple light, ultraviolet light the human being cannot see. It is ultraviolet light that makes some objects sensitive to it fluorescent. The students, motivated, recalled that they have seen films in which the investigative police used negative light to investigate if there was blood in the place examined, that some supermarkets or lottery stores use this type of light to check if the money bills are real or fake. The activity had the active participation of the children, in the sense of carrying out the experiment and associating it with real-life issues.

At the end of the workshop, the workshop teachers asked the students to make a drawing that represented what they had learned during the experiments, that is, what they learned on the day with the interactive activities.

RESULTS AND DISCUSSIONS

To categorize and analyze the data from the research corpus, children's drawings, initially we sought theoretical reference in the methodology of image analysis. The iconological analysis used for data with images, as described in the works of Vicente (2000); Canabarro (2015) and Panofsky (1979). However, it was observed that iconological analysis is more appropriate for works of art, photographic records and advertising images. In view of this situation and also considering the entire corpus of the research, because the data collected did not return only drawings, but drawings, drawings plus text and only text, that is, a mix of information. As a result, not finding a methodology and categories to classify and analyze the data from this work, it was decided to use Content Analysis, according to Bardin (2011) because it is more appropriate, in the perception of the authors of this article. The analysis methodology consists of:

> A set of communication analysis techniques aimed at obtaining, through systematic and objective procedures for describing the content of messages, indicators

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(quantitative or not) that allow the inference of knowledge related to the conditions of production/reception (inferred variables) of these messages. (BARDIN, 2011, p.42)

Content Analysis, according to the author, follows three important steps, namely:

- Pre-analysis (choice of documents; floating reading; constitution of the corpus and preparation of the material);
- Exploration of the material (unit of registration; unit of context and thematic axes);
- Treatment of the results (description of the data; categorization; analysis of the data; interpretation and inferences. (BARDIN, 2011)

Using Content Analysis, the categories and subcategories were created *a posteriori*, because, as previously mentioned, reference categories that could be used in this work were not found in the literature.

The analysis process began with the collection and separation of the material, the drawing and/or textual production of the children who participated in the workshop.

Initially, the collected materials were read and observed (the iconic representation) separately, following the *Exhaustiveness rule*, indicated by Bardin (2011). In this movement of reading and rereading the collected data over and over again, it was possible to observe some trends, or rather, the frequency of occurrence and some congruences, so the material was separated by similarity. From this action and following the steps of the analysis, groupings of the Context Units were created indicating the trends of occurrence, which were decoded as the Initial Themes[5]. Chart 2 presents the Initial Themes, the description corresponding to each theme and the observations from which the information was collected.

Chart 2 – Initial Themes

Starter Theme (frequency of occurrence in percentage)	Description	Grouping observations
T 1 16%	Shows the application of ultraviolet light and how sound can be produced	Drawing and text on sound waves and electromagnetic waves (ultraviolet light)
T2 4%	Representation of experiments performed in context	Drawing showing one of the experiments made with scenarios (classroom and schoolyard)
T3 33%	Explanation of how sound can be produced	Text and/or drawing on sound waves

[5] The Initial Themes were calculated as a percentage, or rather, in relation to the whole as a percentage of the grouping represents

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T4 6%	Mechanical and/or electromagnetic wave representation	Wave design
T5 4%	Explanation of the concept, production and propagation of waves	Text on sound waves and electromagnetic waves (ultraviolet light)
T6 12%	Representation of all experiments carried out in the workshop by the child sequentially.	Drawings representing all the experiments done
S7 25%	Shows the propagation of sound through experiment and how to employ it to play with colleagues	Drawing and/or drawing more text about the corded phone experiment

Source: Prepared by the authors, 2025.

Analyzing the initial themes, three main ideas emerged and to represent them, categories and subcategories were created, *a posteriori.* These categories help to answer the guiding question of this work: How can interactive experiments contribute to the learning of Science when the target audience is children?

The creation of categories and subcategories *a posteriori* is justified because until the moment of the literature review and analysis of the data collected, the teachers/researchers did not find categories of analysis that could encompass the characteristics of the context of the workshop, or rather, interactive experiments of Science applied to students of the 3rd year of Elementary School in a public school. In this sense, it was decided to create the categories and with reference to the subcategories and initial themes, following the Content Analysis methodology proposed by Bardin (2011). The information regarding the groups built, which allowed the creation of the categories, is shown in Chart 3.

Table 3 – Categories and subcategories created a *posteriori*

Categories	Subcategories	Initial themes
1. Meaningful learning	1.1 Construction of meaningful knowledge for children	1.1.1 Shows the application of ultraviolet light and how sound can be produced
		1.1.2 Explanation of how sound can be produced
2. Learning built in the socio-historical context	2.1 Knowledge construction in the context of the school and the workshop	2.1.1 Representation of experiments carried out in the context
		2.1.2 Shows the propagation of sound through experiment and how to use it to play with colleagues
3. Learning scientific concepts	3.1 Construction of scientific concepts through experiments and investigative methodology	3.1.1 Mechanical and/or electromagnetic wave representation

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		3.1.2 Explanation of the concept, production and propagation of waves
		3.1.3 Representation of all experiments carried out in the workshop by the child.

Source: Prepared by the authors, 2025.

The categories created through the analysis were: *meaningful learning; learning constructed in the socio-historical context; learning of scientific concepts.* These categories are derived from the subcategories: construction of knowledge with meaning for children; construction of knowledge in the context of the school and the workshop and the construction of scientific concepts through experiments and investigative methodology. The subcategories were created to represent the meaning of the initial themes recorded in the Registration Unit, as can be seen in Chart 3. Each category will be discussed below.

CATEGORY 1 – MEANINGFUL LEARNING

The planning and development of the workshop were done in such a way that it had the potential to arouse curiosity in children and encourage active participation in them. And according to Freire (1997), the construction of knowledge about the object through an experiment implies the exercise of curiosity. This motivates the subjects to think, to exercise their critical capacity to compare and formulate questions, as well as to be able to see the applicability in the daily life of the subject studied. In other words, something that makes sense to the student.

The answers of students Bil and Gui[6] to the questioning asked, which I learned today in the workshop, bring the application of ultraviolet light to verify whether the banknotes are real or fake. Bil also writes about the application of ultraviolet light in the investigation of murder crimes, made by the police.

[6] The names shown in the images are fictitious.

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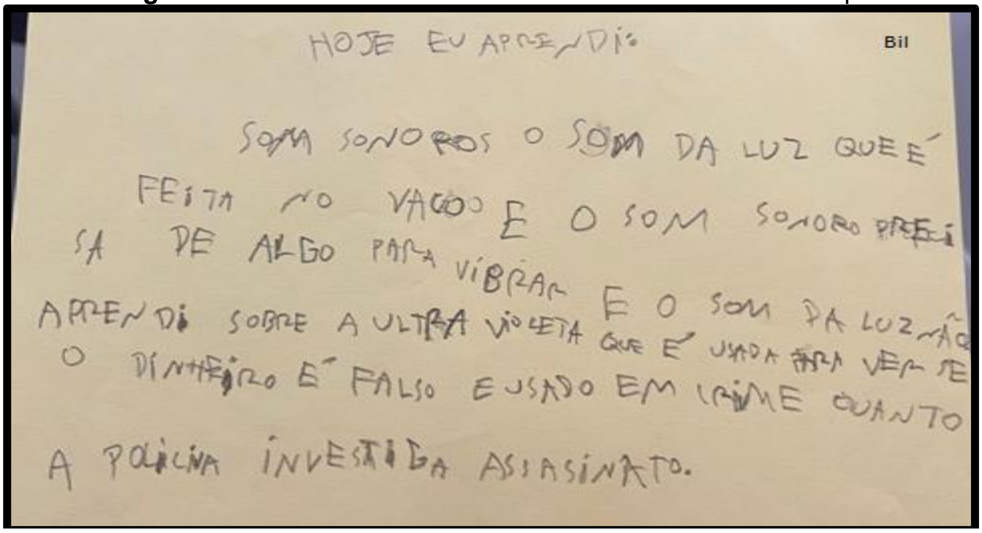
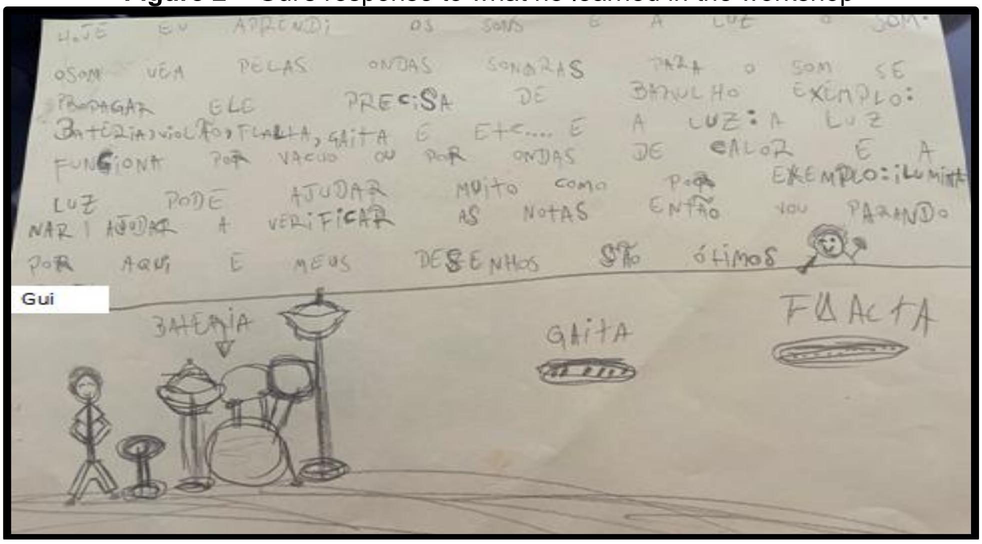
Figure 1 – Bil's answer about what he learned in the workshop



Source: Authors' collection

Figure 2 – Gui's response to what he learned in the workshop



Source: Authors' collection

It should be noted that the students did not take notes during the workshop, except when they used the rattle. They shook the 'instrument' and wrote down what could be the unknown internal object(s), just by the noise it made. In addition, there was no support material or notes. The answers presented to the question: what I learned today in the workshop were the children's own elaborations.

It can be observed that there was evidence of learning, as the children were able to formulate, autonomously, texts and/or drawings that represented the application of ultraviolet light. In Ausubel's (1980) perspective, meaningful and effective learning in the classroom depends on the material that is intended to be taught being potentially meaningful for the student. In this case, through the students' feedback, the workshop shows signs of being potentially meaningful for the children, since it aroused curiosity and was a useful tool for teaching Science.

CATEGORY 2 – LEARNING CONSTRUCTED IN THE SOCIO-HISTORICAL CONTEXT

The school, in this case study, is the place of speech. A place where meetings take place, classes are taught, proposals for activities are made and a place where the workshop was developed collectively. In Vygotsky's (1994) perspective, the construction of knowledge among peers, that is, through colleagues and/or the teacher's help, is important because it accelerates the learning process, because the learning built in the collective enables the awakening of internal processes in the subjects. According to the author:

> Learning awakens several internal developmental processes, which are able to operate only when the child interacts with people in his environment and when in cooperation with his peers. Once internalized, these processes become part of development's acquisitions. (VYGOTSKY, 1994, p.118)

In this bias, there is a visceral relationship between the development of the subject and the sociocultural environment, to the point that the author states that the child would not fully develop without the contribution of other subjects who live in his environment.

Figure 3 shows Bibi's drawing that represents the wired telephone experiment, carried out in pairs. The child also wrote that he learned about musical instruments and how to use the corded telephone (in his writing it appears *cordless telephone*). According to her evaluation, she thought it was cool because she will be able to play with her friends. This speech and drawing bring us information that the student learned to use the corded phone collectively and will share with her friends. She also brings up the question of where she learned in school.

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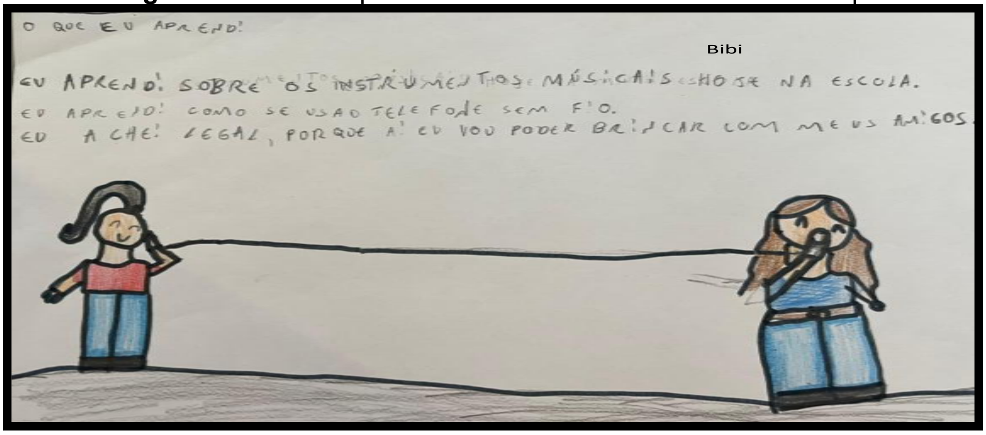
Figure 3 – Bibi's response to what she learned in the workshop

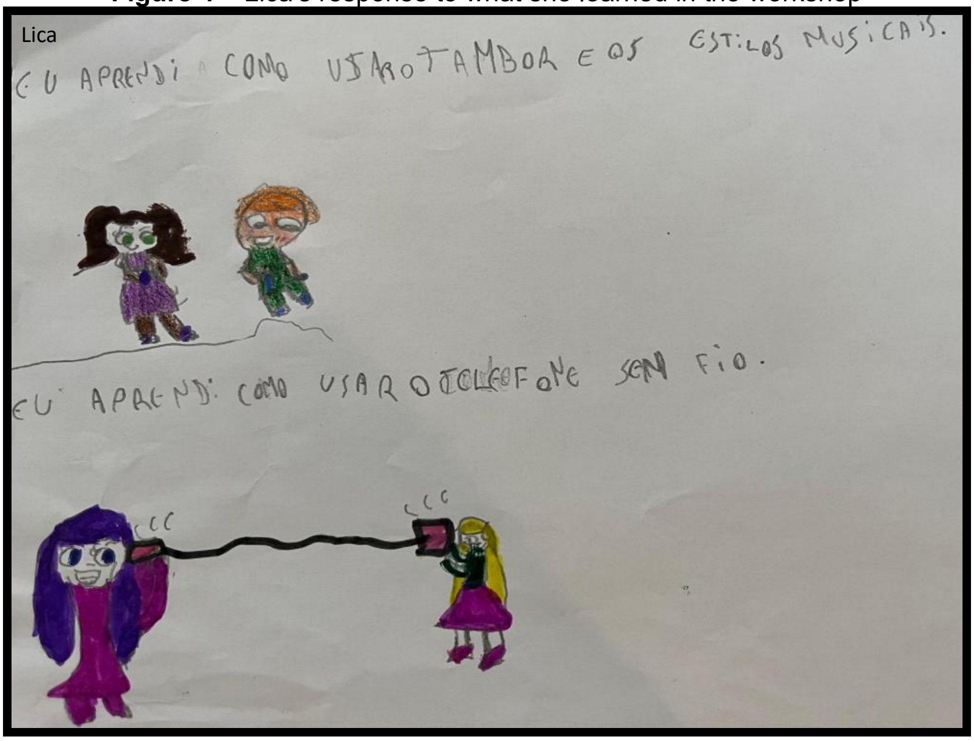


Source: Authors' collection

Again returning to the expression used by Bibi was "*I thought it was cool",* this speech refers to something pleasant. And as stated by Carvalho *et al*.(2007, p.6): "[...] if it makes sense to children, they will like science and the probability of being good students in later years will be greater".

Figure 4 is Lica's answer about what she learned in the day's workshop. The student makes the drawing to represent the wired telephone experiment, making it clear that one person is talking and the other is listening (which also appeared in Bibi's drawing). Through the image, it is expressed that the task was carried out with the help of another colleague.

Figure 4 – Lica's response to what she learned in the workshop



Source: Authors' collection

Lica writes that she learned to use the corded telephone (a term used by the *cordless telephone,* which is actually a corded telephone*),* use the drum and learned the musical styles. According to Millar (2014), it is important for children to manipulate concrete materials, as this experimentation helps in the understanding of phenomena that occur in the subject/object interaction.

Returning to figure 4, in both drawings there is an illustration of two children, which can be interpreted as the place where the child says he has learned, at school. This shows that learning did not occur in isolation, but within the socio-historical context. This factor, according to Vytosky (1994), is of paramount importance, because children learn and develop more quickly with their peers, when inserted in communities.

CATEGORY 3 – LEARNING OF SCIENTIFIC CONCEPTS

The learning of scientific concepts can begin from the initial grades, but gradually and progressively through systematized teaching. However, we have to consider how scientific concepts will be taught, because according to Vygostky (2008 p.104) "experience shows that direct teaching of concepts is impossible and fruitless".

It is not constructive and useful to merely conceptualize, followed by repetitions for children to learn scientific concepts. It is necessary to think about involving students in the proposed activities, questioning what they already know and, based on this framework, proposing the active participation of students in the construction of their knowledge.

All the experiments involved in this workshop were created to try to involve the children in the investigative method. Starting with the guiding question, in this case of the workshop the question was: How can we create sound?

From the questioning, it is believed that the seed of curiosity was planted, arousing the interest to do interactive experiments, observe the phenomena, try to understand what happened (cause and effect) and, mainly, pay attention to the explanations of the workshop teachers.

All this movement contributes to the fact that some spontaneous concepts of the children (those concepts constructed through experiences) were replaced by scientific concepts. Of course, scientific concepts are often not complete, they are reconstructed and become more complex and robust as the child learns systematically at school, especially in

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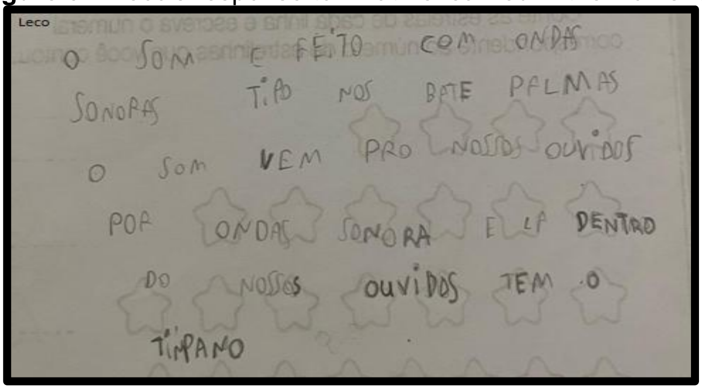
the age group of the students (8 and 9 years old) investigated in this work. Figures 5 and 6 are the answers of three students about what they learned in the workshop.

Student Leco writes that sound is made with sound waves, that sound reaches our ears through sound waves. This statement is an indication that the student understood and was able to elaborate with his own words a concept of Physics. Sound is a mechanical wave, which propagates in material environments (in this case, through atmospheric air) and reaches our ears, sensitizing the eardrum. It is a definition still under construction, but for a child in the 3rd year of Elementary School it is relevant, since it involves elaborating, alone, an answer containing a scientific concept.

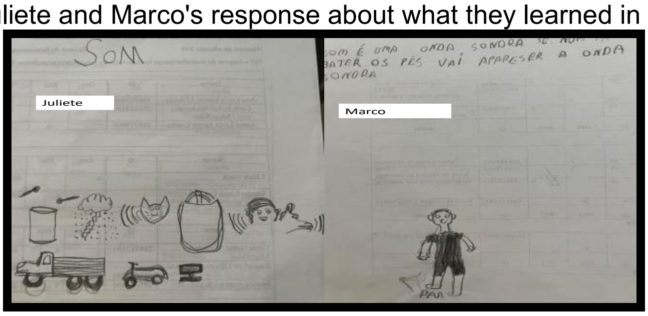
Figure 5 – Leco's response to what he learned in the workshop



Source: Authors' collection

Figure 6 shows the answer of two students about the question asked to all students at the end of the workshop. The image on the left is a drawing of Juliete that illustrates various forms of sound production; It represents a drum, the rain, a cat meowing, a speaker, a person talking, a dog barking, a truck, a motorcycle and a computer. In the illustrations of the cat, the person and the dog, she makes lines near their mouths, which we interpret as sound waves propagating in the air. A concept also from Physics is that sound waves propagate in the form of longitudinal mechanical waves.

Figure 6 – Juliete and Marco's response about what they learned in the workshop



Source: Authors' collection

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In the same figure 6, on the right, we have Marco's answer. The student writes that sound is a sound wave and cites an example of how to produce a type of sound, a tapping with the feet on the ground.

He reinforces the example mentioned with a drawing, which represents a boy tapping his foot on the ground. In this speech and drawing, there is an indication that the student knows how to produce a sound wave and also that he has learned to associate this action with a concept, or rather, that sound is a wave.

FINAL CONSIDERATIONS

An exploratory research is the beginning of an investigation, still with fragile and often incipient data to bring answers with a theoretical framework. However, this type of study is important to bring new clues and suggestions for paths to be followed in more depth in future research.

By investigating how interactive experiments can contribute to the learning of Science when the target audience is children, we obtained pleasant surprises, especially regarding the students' interest in performing interactive experiments and trying to understand what was happening. Another issue that we also consider positive was that all students did the final task requested, that is, they answered in the form of a drawing, drawing plus text or text what they learned while taking the workshop. This was fundamental for us to have data and analyze it.

By carrying out the data analysis process, it was possible to understand, in this case study, that the main contribution of interactive experiments in children's learning was the construction of knowledge. The emerging categories, *a posteriori, (i) Meaningful learning, (ii) Learning constructed in the socio-historical context* and *(iii) Learning of scientific concepts*, are the supports that allow us to infer that there was learning through the construction of scientific knowledge, regarding the themes of Science proposed in the workshop. In addition, we also need to look at the path taken by the children, because during the workshops there were exchanges of knowledge, complicity, collaboration and integration, that is, important social actions for the development of human beings.

In this sense, it is believed that the objective proposed for the realization of the workshop was fulfilled. As for meeting the specific objectives, we can say that yes, some were achieved, since there was scientific dissemination, we promoted the learning of scientific concepts (of course for the age group served) and there was cooperation between teachers from the public school of Taquara served and the IFRS – Campus Rolante. As for the specific objectives: to stimulate research and appreciation of the school as a learning environment, there was not enough time and information to infer such aspects.

Finally, it cannot be overlooked that the children carried out the proposed activities as if it were a good game, in a light and fun way.

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