MEDICINAL PLANTS AS A GENERATIVE THEME FOR THE STUDY OF ORGANIC FUNCTIONS AND SCIENTIFIC LITERACY IN CHEMISTRY

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ABSTRACT

Chemistry teaching requires the use of approaches that provide students with conditions so that they can critically interpret the reality in which they live. This implies the need to link the content worked with the social context in which the student is inserted. However, the practice of contextualizing is rarely addressed in the classroom, especially when it comes to teaching Organic Chemistry. Therefore, this research aimed to propose a didactic intervention based on the theme of medicinal plants as a proposal to integrate the student's daily life with the construction of knowledge about Organic Functions, in order to make the teaching and learning process more meaningful in accordance with the proposal for Scientific Literacy. The research was carried out with students from a 3rd year class of Integrated Technical High School in Computer Science for the Internet at the Federal Institute of Education Science and Technology Baiano - Campus Guanambi, in the period

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between November 2022 and May 2023 and involved six stages, with diverse activities. The use of the theme met the objectives of the study proposal, as, depending on the receptivity of the participants, it constitutes a teaching resource that brought the study of Organic Functions closer to everyday life, favoring more meaningful learning. The proposed use of the generating theme also demonstrated that it aroused the students' curiosity and interest, given their active participation in the construction of knowledge, which may have contributed to the teaching and scientific literacy processes.

Keywords: Medicinal plants. Teaching. Organic functions. Scientific literacy.

INTRODUCTION

Chemistry is the branch of science that studies the composition, structure and properties of matter, as well as the changes undergone during chemical reactions and their relationship with energy. As a science, Chemistry provides individuals with an understanding of the most varied phenomena that occur in the environment in which they are inserted, so that they can operate as a transformative agent in this environment (Zanotto; Silveira; Sauer, 2016). As transformation requires knowledge, Chassot (2018), argues that Science, a large area in which Chemistry is inserted, is a language and the scientifically literate individual is the one capable of interpreting this language and collaborating to predict and control the changes that occur. in nature.

However, Chemistry, even today, is considered a subject much feared by students, since this component is seen as difficult to understand, abstract and distant from their social context. Several factors have contributed to students' perspective on this science moving from incomprehension to lack of interest. One of them is due to the content being based on memorization and mechanized teaching, the other is due to the absence of a practical relationship between the concepts worked on in the classroom and everyday situations (Machado, 2021).

According to Vieira (2016), these difficulties become even more accentuated in the teaching and learning process of students when it comes to the area of Organic Chemistry. The author considers that such difficulties occur due to the demands of memorizing the rules of nomenclature and classification of carbon chains, subjects that are addressed in isolation in the third year of high school in a way that is decontextualized from the students' social reality. Therefore, Chemistry must be presented based on teaching strategies that can provide greater interest and provide students with concrete experiences that lead them to analyze, understand and question phenomena that occur around them (Santiago, 2019).

In this aspect, it is necessary to make use of alternatives that can minimize students' difficulties in understanding the contents listed in Organic Chemistry, as well as promoting Scientific Literacy in Science teaching. To achieve this, numerous paths have been considered, one of them is through teaching approach strategies using generating themes.

According to Braibante *et al*. (2014), the use of generating themes such as teas, in the classroom, has an important role, as it makes it possible to work on various topics in Organic Chemistry, based on the chemical structures of the active principles present in medicinal plants, such as for example: nomenclature of organic compounds and identification of functional groups, as well as supporting the promotion of the study of facts, phenomena and objects present in students' daily lives, helping them to interpret everyday

situations through scientific content involved. Still from the perspective of Scientific Literacy, the theme also allows reflection on various problems, such as the correct and conscious use of medicinal species (Silva *et al.*, 2017).

In this sense, this study focused on proposing a methodological approach based on the Medicinal Plants theme as a proposal to integrate the student's daily life with the construction of knowledge of the Organic Functions content in order to make the teaching and learning process more meaningful in accordance with the Literacy proposal Scientific.

TEACHING ORGANIC FUNCTIONS AND MEDICINAL PLANTS

Organic Chemistry is considered a part of Chemistry that studies compounds that have carbon as the main chemical element, which are classified into different organic functions, according to their structures and physical and chemical properties. These organic compounds play an essential role in the maintenance of living beings, as they are present in clothes, food, pharmaceutical products, among others, which are part of our daily lives (Silva, 2019).

Although Brazilian education has reformulated issues regarding the formal curriculum, such as the adoption of the National Curricular Parameters (PCN) and the National Common Curricular Base (BNCC), it is clear that the teaching of the contents of the Chemistry curricular component in high school, notably in the area of Organic Chemistry, is still generally transmitted in a traditional and decontextualized way from students' daily lives (Machado, 2021). According to Maia (2019, p.15):

> The development of Chemistry classes using traditional methods is considered boring and meaningless, making learning difficult, causing lack of interest and low performance. Researchers confirm that contextualized classes, worked with bibliographical research, aimed at searching for new information within the student's practice and reality, establish an interesting connection between the knowledge acquired through the students' experience and abstract concepts or concepts that are difficult to understand.

When working on the content of organic functions in the classroom, the focus is only on the direct application of the formulas and the recognition of the functional group without making practical connections with the students' daily experiences (Lima, 2017). Therefore, the way this content is explained, that is, the absence of a practical relationship between these functional groups and their respective physical, chemical or even pharmacological properties, has led the student to label Organic Chemistry as difficult to understand. learn, as well as that it has no connection with the student's experience (Silva *et al*., 2017).

One way to prevent this distorted conception of Organic Chemistry on the part of students from becoming even more accentuated, as well as promoting more attractive and

participatory classes, which can sharpen students' curiosity and interest, would be through contextualization using a theme that has a link with their daily lives (Silva *et al*., 2017). In this sense, Rockenbach *et al*. (2020) defend the use of the theme of medicinal plants to address the subject of organic functions, as this knowledge is passed on through generations, with medicinal plants being the predominant therapeutic resource throughout the development of humanity and still used to this day.

The theme can be explored in classes, since medicinal plants have compounds with molecular structures, the chain of which can present one or more functional groups, which are responsible for the therapeutic effect of the plant and are organized into different groups according to their similarity chemical. They can be classified into terpenes, triterpenes, tannins, saponins, flavonoids, alkaloids, etc. (Silva; Pinheiro, 2021).

Brito *et al*. (2019) also highlight that the theme of medicinal plants can be strategically used as a teaching resource with a view to enabling the approximation of popular culture to scientific knowledge so that, from this, students can reconcile the knowledge acquired through family life with knowledge school, therefore making learning more meaningful, as well as attributing value to local culture.

Silva *et al*. (2017) also corroborate this idea by stating that taking into account a subject that is widespread in the region and used in students' daily lives, such as medicinal plants, favors and stimulates the search for knowledge, since through this approach students are able to perceive the importance of educational content in their lives, contributing to the formation of more aware citizens capable of opting for a healthier lifestyle. The authors also emphasize that the use of the aforementioned theme also allows reflection on various problems, such as the preservation and correct use of medicinal species.

SCIENTIFIC LITERACY

The term Scientific Literacy refers to the set of knowledge constructed by the individual so that they are able to read, understand and transmit in an intelligent and critical way what they think about subjects involving science.

One of the main pillars for Scientific Literacy concerns the training of citizens with a critical stance capable of not only “reading” the world, but proposing improvements around them (Chassot, 2018). Ferino (2020) confirms this idea by stating that, for a subject active in contemporary society, it is necessary, in addition to basic survival needs, to develop skills that enable him to intervene in the environment in which he is inserted. In this sense, as Neto (2020, p. 3) points out:

> It is important to be scientifically literate to understand the conditions, meanings and even the excesses that Sciences and the developments related to them can generate in the face of the various transformations that our society has experienced. People must make decisions and participate in discussions related to various events in the world.

Therefore, for individuals to be able to construct scientific concepts and develop skills such as critical and reflective positioning on individual and collective decisions, Science teaching must be planned in such a way that the student participates in this process, since We are responsible for our actions and what we do and decide will impact, in some way, on society as a whole (Marcondes, 2018).

From this perspective, Science teaching needs to be established in order to privilege the investigation of phenomena linked to the student's daily life, so that they can be able to master and use knowledge relating to areas of their life. However, as Miranda *et al*. (2015) points out, it is necessary to pay attention to this process, since scientific literacy goes far beyond simply understanding everyday knowledge, but also in the ability to systematize knowledge in a logic, as well as assisting the construction of critical knowledge of the world that surrounds us, in such a way that we can understand the expressions through which it is reflected. According to the reflections of Chassot (2018), one of the signs of Scientific Literacy is the understanding of the transformations in the world, which does not just mean accepting them, but rather having the ability to reflect with critical thinking, thus avoiding being deceitfully led by society. Parallel to this, Machado (2021) also points out two other very relevant indicators, which are the construction of logical reasoning and the raising of hypotheses, expressed by the exposition of thought, which can occur both in the form of a statement and a question, results relationship, reorganization and search for new information by the scientist.

An interesting way to promote students' Scientific Literacy is to develop teaching based on the use of themes related to their daily lives, as they attribute importance and meaning to what is studied (Branco, 2020). In this way, as Neto (2020) highlights, the theme of medicinal plants for the promotion of Scientific Literacy is positive, given that it is part of the cultural practice of a given place and collective group.

In this sense, scientific education must present itself as honoring, in addition to scientific knowledge, dialogue with other forms of knowledge such as, for example, popular knowledge. This knowledge, called “primal knowledge", can serve as an awakening to scientific knowledge, and through the process of “rediscovering” what is known, the production of new knowledge and the differentiation between the vulgar and the real occurs (Chassot, 2018).

METHODOLOGY

METHODS AND TECHNIQUES

The present study is characterized as action research. For Thiollent (2005), this type of methodology is social research with an empirical basis, which aims to provide research subjects, participants and researchers with the means to be able to respond to the problems they experience with greater efficiency and based on a transformative action. Tripp (2005, p.445) highlights that:

> It is important to recognize action research as one of the countless types of action research, which is a generic term for any process that follows a cycle in which practice is improved through the systematic oscillation between acting in the field of practice and investigating about it. her. A change is planned, implemented, described and evaluated to improve your practice, learning more, in the process, both about the practice and the investigation itself.

Although the aforementioned authors consider action research to be a predominantly qualitative methodology, we opted for a qualitative-quantitative approach as a way of analyzing and discussing the data in this research, since, according to Souza and Kerbauy (2017), these two types of approaches complement each other and can be used together in research, as they enable a better understanding of the educational phenomena investigated, which increasingly present themselves from multiple facets.

Qualitative research has been gaining prominence in the area of education, due to its complexity and difficulties in working with variables, while quantitative research allows a more holistic view of the problems of the reality that surrounds us. In this way, quantifications can reinforce the conclusions obtained from qualitative research (Schneider; Fujill, Corazza, 2017).

SUBJECTS

The research was carried out with students from a 3rd year high school class of the Integrated Technician course in IT for the Internet at the Federal Institute of Education, Science and Technology Baiano Campus Guanambi, and was carried out with 31 students. The choice for students in the 3rd year of High School is due to the large area of Organic Chemistry being taught in the last year of the final phase of Basic Education.

PHASES OF THE INVESTIGATION

The study was carried out in the period between November 2022 and May 2023. Most of the activities were carried out during Chemistry classes, in the morning shift, however the bibliographic research activity was carried out in a non-formal environment.

The methodological development involved six stages, totaling six classes of 60 minutes each, as shown below.

(i) Presentation of the proposal to the class and application of the initial questionnaire to survey students' prior knowledge on the topic “medicinal plants”;
(ii) Presentation of the mini-course entitled “Shall we research? How to carry out scientific research on safe websites on the internet." This moment aimed to develop students' curiosity and ability with scientific research;
(iii) Bibliographical research activity on the medicinal plant described by the student in the initial questionnaire. At this point, a literature review on the use of the aforementioned medicinal plant was proposed. With this, each student created a sheet with the following information about the plant: popular and scientific name, part used, therapeutic indications and pharmacological action, major active ingredients with their respective chemical structures, contraindications, as well as illustrations that facilitate the recognition of the plant. and the copies;
(iv) Contextualized class using the generating theme “Medicinal Plants”. At this point, the basic characteristics for the recognition and differentiation between the main Organic Functions (alcohol, phenol, enol, aldehyde, ketone, carboxylic acid, ester, ether, amine and amides) were addressed, through chemical structures of active principles present in medicinal plants, so that the relationship with pharmacological properties were emphasized.
(v) Recognition of the functional groups present in the chemical structure of the majority active ingredient of the medicinal plant, for which bibliographical research was carried out in stage three.
(vi) Exhibition of the educational product, that is, the booklet, in physical and virtual form, accessible via QR Code, drawn up based on research carried out by students on medicinal plants, and assessment of the acceptability of the methodological approach using the generating theme “Plants Medicinals” and their contributions to the teaching-learning process, categorized based on a semi-structured questionnaire.

RESULTS AND DISCUSSION

ANALYSIS AND DISCUSSION OF THE INITIAL QUESTIONNAIRE

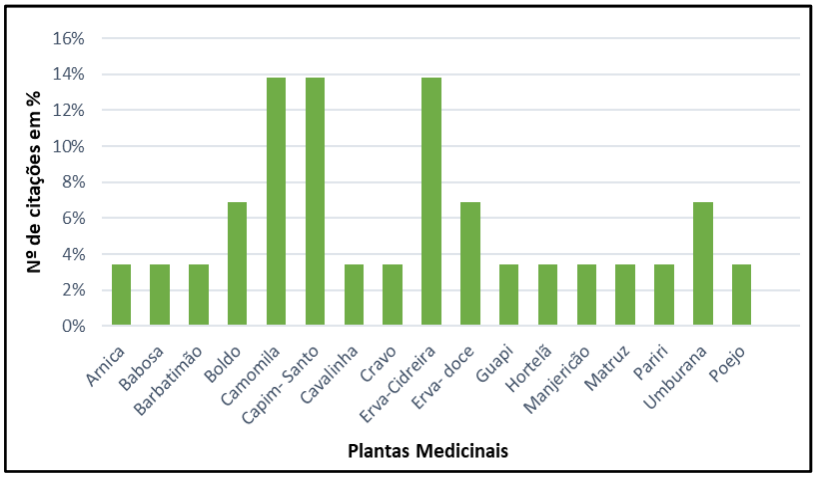
As described in the methodology, the first stage consisted of a presentation of the project and collection of information through the application of an initial questionnaire.

Therefore, it was decided to fully transcribe the subjective responses, in descriptive excerpts, while multiple-choice responses were displayed through graphics.

According to Silva *et al*. (2017), it is interesting that the teaching of Sciences such as Chemistry is worked in a contextualized way, that is, using themes that are linked to the student's daily life. Therefore, the initial questionnaire was applied with the aim of collecting information about the knowledge that students already had regarding medicinal plants and thus obtaining support to develop the topic from their perspectives. Therefore, in order to find out whether the topic was really part of the students' daily lives, they were initially questioned regarding the use of medicinal plants in their homes. Of the 29 students who responded to the questionnaire, all stated that they had already used it. The significant number of students who responded affirmatively was expected, since the use of medicinal plants is ancient, as it is characterized as a practice that has been developed since ancient times and has been preserved through generational transmission. generation, constituting what we know as popular medicine (Silva, 2012). Therefore, this quantity justified the proposed approach to the topic with the respective class.

In the following question, students were asked to name at least one medicinal plant known and consumed in their family circle. The answers to this question are illustrated in Figure 1.

Figure 1. Medicinal plants mentioned by students



Source: Prepared by the authors

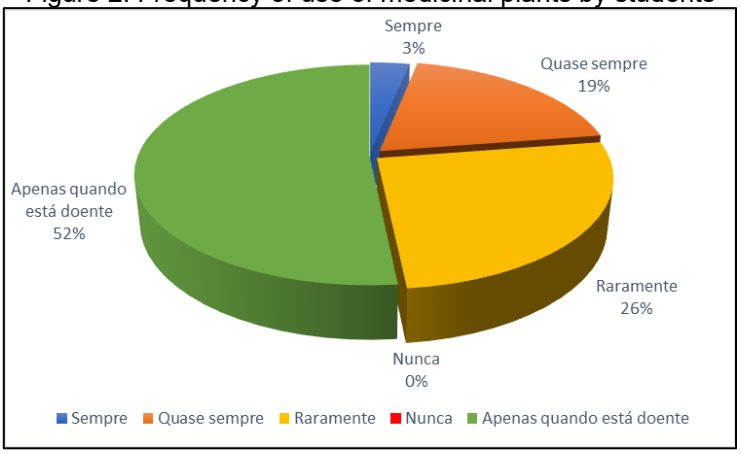
According to Figure 1, 17 species of medicinal plants were cited by the students, among these it was found that lemongrass, chamomile and lemon balm are among the most commonly used by students, whose number of citations in percentage was equal to 14%. According to Lorenzi and Matos (2002), these species are widespread in society, since they have greater ease of adaptive development and, therefore, are found in any environment.

Several works such as Rocha *et al*. (2021) reinforce this information by stating that chamomile is considered widely used in Brazil and can be easily found in supermarkets, drugstores, convenience stores, among others. Studies carried out by Sousa *et al*. (2018), which sought to verify popular knowledge about the consumption of plants for medicinal purposes in a given sample, also revealed lemongrass, chamomile and lemon balm as the most cited species.

The students were also asked about the therapeutic purpose for which they used the described medicinal plant. In view of this, chamomile and lemon balm were mentioned for calming uses, boldo for digestive problems, guapi for flu-like symptoms, among others. With these answers, it was noted that the students already had knowledge about the benefits provided by the use of these plants, information that can be proven through chemical studies carried out by the works of Do Vale *et al*. (2002), who listed that chamomile (*Matricaria chamomilla* L.) and lemon balm (*Melissa officinalis* L.) have a proven calming action, due to the presence of citral, its major constituent, and the presence of the flavonoid apigenin in its composition. Studies such as that by Czelusniak *et al*. (2012), indicate that coumarin, present mainly in the leaves of Guapi (*Mikania glomerata* spreng), is the main metabolite, which stands out for its pharmacological actions, such as anti-flu and expectorant. While boldine, an alkaloid present in boldo (*Peumus boldus* Mol.) has antioxidant and anti-inflammatory potential, which is why it can be used against gastrointestinal cramps (Zanotto; Silveira; Sauer, 2016).

Students were also asked about the frequency of use of medicinal plants. Figure 2 shows that 52%, that is, the majority of students, use medicinal plants only when they are sick, 19% claimed to use them almost always, while 26% use medicinal plants rarely.

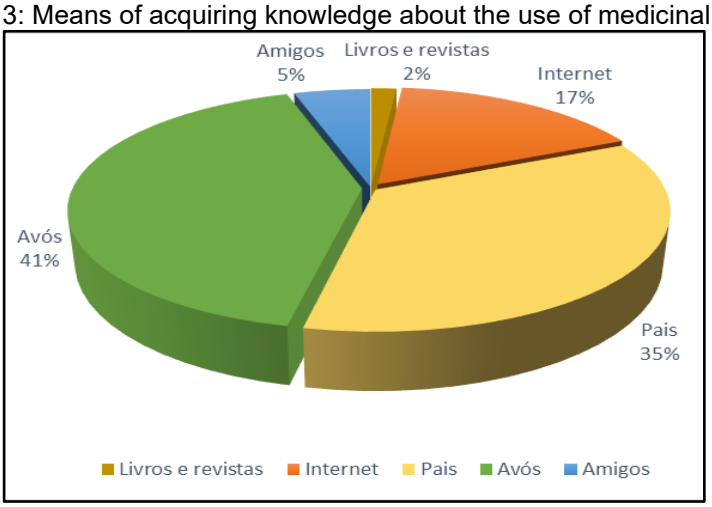
Figure 2. Frequency of use of medicinal plants by students



Source: Prepared by the authors

Carvalho (2011) emphasize that the use of medicinal plants as an alternative to promote or maintain health has been increasing over the years, due to their high healing and natural power, as well as the difficulty of access to medical care for the poorer population. According to these authors, the use of medicinal herbs is favorable to human health, provided that the user has initial knowledge of their utility, risks, and benefits. In this regard, in the following question, the students were asked how they acquired the knowledge they had about medicinal plants. As shown in Figure 3, it was observed that the majority of respondents stated that the information about the purpose of using these plants was obtained from family members, such as grandparents and parents, with percentages of 41% and 35%, respectively. This demonstrates that the culture of using medicinal plants for therapeutic purposes has been formed by popular knowledge passed down from generation to generation over the centuries, mainly recorded through so-called home remedies, primarily taught by parents and grandparents (Brizzolla, 2018; Firmo, 2011).

Figure 3: Means of acquiring knowledge about the use of medicinal plants



Source: Prepared by the authors

After the general inquiries, the students were questioned about the relationship between Organic Chemistry and medicinal plants. In this regard, 72.4% of the students responded that they believed in the existence of this association; however, only 43% were able to justify why this relationship exists, as follows:

> "Yes, since medicinal plants are composed of organic compounds, which are the subject of study in organic chemistry." (STUDENT A)
>
> "Every food, including medicinal plants, is composed of organic substances. Therefore, their properties are directly related to Organic Chemistry." (STUDENT B)
>
> "The active principles found in medicinal plants contain carbon in their composition, therefore, they constitute organic functions." (STUDENT C)

On the other hand, 27.6% claimed not to see this relationship. This demonstrates that, although more than half of the students showed that they can perceive a connection between Organic Chemistry and the pharmacological properties of medicinal plants, a significant portion of the students demonstrated difficulty in identifying that their composition contains organic substances that are responsible for providing health benefits. It can be inferred that the approach to the topic associated with Organic Chemistry was not used in the class and/or the students who demonstrated the association acquired the knowledge through other means, or the approach and learning were not significant for the 27.6% of students.

Finally, the following question was asked: "In your opinion, what makes learning Chemistry more difficult?" Below are some of the students' responses to this question:

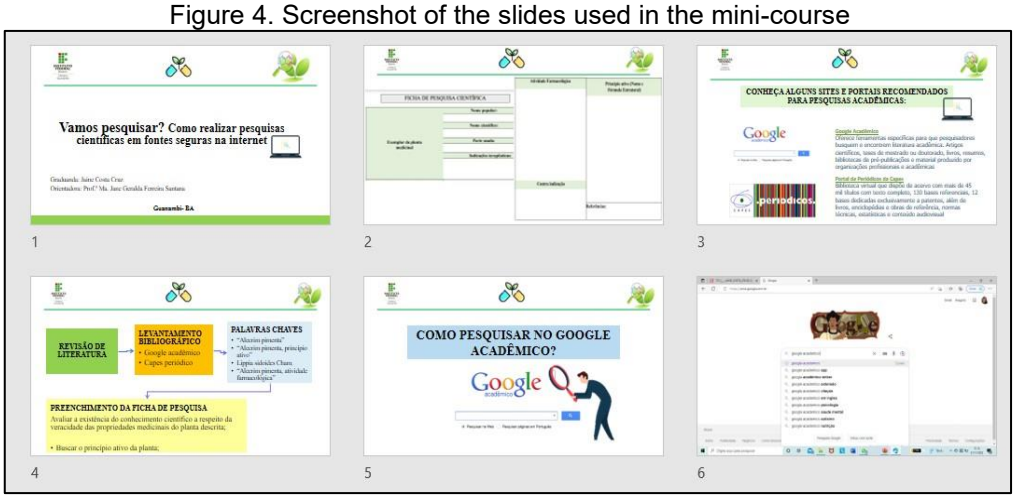
> "The complexity of the subject, without relating it to everyday life, makes it difficult to understand how chemistry really works." (Student A)
> "Because of the multitude of formulas and rules about the structure of these." (STUDENT B)

This result corroborates the arguments of Marcondes (2015), who reports that the excessive emphasis given to rules, classifications, nomenclatures, and formulations of organic compounds is one of the major problems in teaching and learning these concepts in school.

TEACHING INTERVENTION AND ITS RAMIFICATIONS

The production of scientific knowledge depends on research processes, and one of the skills that can classify individuals as scientifically literate is the ability to distinguish between scientific findings and personal opinions (Carvalho, 2011). With the phenomenon of globalization and rapid access to information facilitated by the emergence and advancement of Information and Communication Technologies (ICTs), the identification of research papers and results on various topics has been somewhat stimulated and facilitated (Jesus; Lima, 2012). With this in mind, shortly after the initial problematization of the topic, aiming to develop students' curiosity and skills in scientific research, a mini-course was conducted with the theme: "LET'S RESEARCH? How to conduct scientific research using secure internet sources," as shown in Figure 4.

Figure 4. Screenshot of the slides used in the mini-course



Source: Prepared by the authors

In this mini-course, students were introduced to some websites for searching scientific information on the internet. Among the many tools for research, the use of *Google Scholar* (GS) was demonstrated as a resource for accessing scientific information, including its functionalities and applications. As Gaudêncio, Figueiredo, and Leite (2009, p. 16) state:

> Google Scholar provides a simple way to search scholarly literature comprehensively. You can search across many disciplines and sources in one place: peer-reviewed papers, theses, books, abstracts, and articles from academic publishers, professional societies, preprint repositories, universities, and other scholarly organizations. Google Scholar helps you find the most relevant research from the academic world.

During the mini-course, all students argued that they were already familiar with the tool; however, more than half had already used it, but they reported being less familiar with its functionalities. Students' knowledge about this tool is due to the verticalization of education in Federal Institutes (IFs), which allows the integration of various technical and scientific knowledge on-site, so that the practice of scientific research is not limited to Higher Education and Post-graduation but also extends to other levels and modalities such as High School and Technical Education (Nascimento, 2021). Furthermore, these students are already in the third year of the Technical Course in Internet Computing, which justifies their acquisition of this knowledge.

All of this contributes to providing students with the opportunity to develop research, extension, and innovation activities as academic and technical-scientific productions, through the Integrative Project, one of the disciplines in the curriculum of the course, as well as benefiting from access to the institution's infrastructure and other aspects inherent to the Internet Computing Technical Course (laboratories, workshops, computer labs with various specific programs, communication equipment, among others). Another reason for the broad access can be supported by the simplicity and practicality of using Google Scholar (GS).

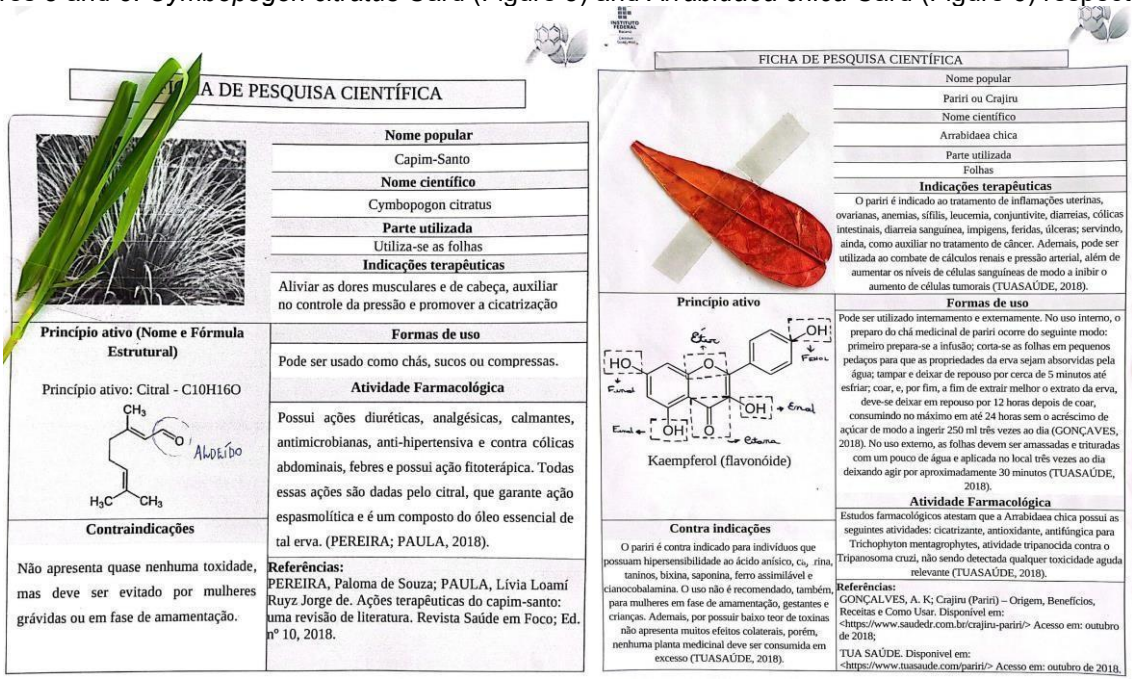
Another database explored with the students was the Capes Periodicals Portal. This is a Brazilian portal of scientific and technological information, provided by the Federal Government to the Brazilian Education System and maintained by the Coordination for the Improvement of Higher Education Personnel (CAPES), a research funding institution linked to the Ministry of Education (MEC). The choice of the Portal as a research source is due to its being a virtual library that gathers and provides internationally comprehensive scientific productions that meet the demands of academic, productive, and governmental sectors, as well as being a tool for the evaluation and regulation of postgraduate courses of great importance for promoting scientific research in Brazil. The main objective of the Portal is to enable free and open access to safe and up-to-date scientific and technological information produced worldwide (Duarte, 2010).

Regarding the use of the Capes Periodicals Portal by students, the majority argued during the mini-course that they do not use this research source, a fact that can be justified by Fernandes and Cendón (2015), such as: unawareness of the Portal's existence, use of other resources, lack of necessity to use the Portal, as well as difficulty in operation, among other factors that end up rejecting its use.

In this sense, the mini-course was important as it provided students with a better understanding of these databases, which are now of utmost importance for seeking useful, safe, and fast information, as well as enhancing the skills necessary to ensure access to and use of relevant information.

After the mini-course, a literature review activity was proposed using the databases explored in the mini-course. Each student was tasked with conducting a literature review encompassing pharmacological and chemical aspects of the medicinal plant mentioned by them in the initial questionnaire. These bibliographic searches conducted by students generated 31 cards containing information about the medicinal plant, such as its common and scientific name, parts used, indications and pharmacological action, major active principles with their respective chemical structures, contraindications, and illustrations that facilitate plant recognition. Figures 5 and 6 provide examples of the scientific cards produced by the students.

Figures 5 and 6: *Cymbopogon citratus* Card (Figure 5) and *Arrabidaea chica* Card (Figure 6) respectively.



A DE PESQUISA CIENTÍFICA

Nome popular
Capim-Santo
Nome científico
Cymbopogon citratus
Parte utilizada
Utiliza-se as folhas
Indicações terapêuticas
Aliviar as dores musculares e de cabeça, auxiliar no controle da pressão e promover a cicatrização

Princípio ativo (Nome e Fórmula Estrutural)
Princípio ativo: Citral - C10H16O
Aldeído
Formas de uso
Pode ser usado como chás, sucos ou compressas.
Atividade Farmacológica
Possui ações diuréticas, analgésicas, calmantes, antimicrobianas, anti-hipertensiva e contra cólicas abdominais, febres e possui ação fitoterápica. Todas essas ações são dadas pelo citral, que garante ação espasmolítica e é um composto do óleo essencial de tal erva. (PEREIRA; PAULA, 2018).
Contraindicações
Não apresenta quase nenhuma toxidade, mas deve ser evitado por mulheres grávidas ou em fase de amamentação.
Referências:
PEREIRA, Paloma de Souza; PAULA, Lívia Loamí Ruyz Jorge de. Ações terapêuticas do capim-santo: uma revisão de literatura. Revista Saúde em Foco; Ed. nº 10, 2018.

FICHA DE PESQUISA CIENTÍFICA

Nome popular
Pariri ou Crajiru
Nome científico
Arrabidaea chica
Parte utilizada
Folhas
Indicações terapêuticas
O pariri é indicado ao tratamento de inflamações uterinas, ovarianas, anemias, sífilis, leucemia, conjuntivite, diarreias, cólicas intestinais, diarreia sanguínea, impigens, feridas, úlceras; servindo, ainda, como auxiliar no tratamento de câncer. Ademais, pode ser utilizada ao combate de cálculos renais e pressão arterial, além de aumentar os níveis de células sanguíneas de modo a inibir o aumento de células tumorais (TUASAÚDE, 2018).

Princípio ativo
Kaempferol (flavonóide)
Formas de uso
Pode ser utilizado internamente e externamente. No uso interno, o preparo do chá medicinal de pariri ocorre do seguinte modo: primeiro prepara-se a infusão; corta-se as folhas em pequenos pedaços para que as propriedades da erva sejam absorvidas pela água; tampar e deixar de repouso por cerca de 5 minutos até esfriar; coar, e, por fim, a fim de extrair melhor o extrato da erva, deve-se deixar em repouso por 12 horas depois de coar, consumindo no máximo em até 24 horas sem o acréscimo de açúcar de modo a ingerir 250 ml três vezes ao dia (GONÇAVES, 2018). No uso externo, as folhas devem ser amassadas e trituradas com um pouco de água e aplicada no local três vezes ao dia deixando agir por aproximadamente 30 minutos (TUASAÚDE, 2018).
Atividade Farmacológica
Estudos farmacológicos atestam que a Arrabidaea chica possui as seguintes atividades: cicatrizante, antioxidante, antifúngica para Trichophyton mentagrophytes, atividade tripanocida contra o Tripanosoma cruzi, não sendo detectada qualquer toxicidade aguda relevante (TUASAÚDE, 2018).
Contra indicações
O pariri é contra indicado para indivíduos que possuam hipersensibilidade ao ácido anísico, cu, rina, taninos, bixina, saponina, ferro assimilável e cianocobalamina. O uso não é recomendado, também, para mulheres em fase de amamentação, gestantes e crianças. Ademais, por possuir baixo teor de toxinas não apresenta muitos efeitos colaterais, porém, nenhuma planta medicinal deve ser consumida em excesso (TUASAÚDE, 2018).
Referências:
GONÇALVES, A. K; Crajiru (Pariri) – Origem, Benefícios, Receitas e Como Usar. Disponível em: <https://www.saudedr.com.br/crajiru-pariri/> Acesso em: outubro de 2018;
TUA SAÚDE. Disponível em: <https://www.tuasaude.com/pariri/> Acesso em: outubro de 2018.

Source: Prepared by students C and E, respectively

During this moment, it was possible to emphasize the importance of the proper use of medicinal plants, as well as to verify the existence of studies that prove the efficiency of the respective mentioned plant and thereby elucidate the relationship between popular knowledge, which is intuitive, spontaneous, with a strong inclination for errors as it is not studied, analyzed, and proven, and scientific knowledge, which in turn aims to study and clarify hypotheses. It is worth noting, however, that both are fundamental to science, as according to Silva and Silva (2015), traditional knowledge brings the importance of life experience itself, and the combination of both benefits from different perspectives and the effort to understand.

It was noted that this activity was quite significant for the students, as they showed commitment to scientific research and the construction of the cards. During this time, a large part of the students reported that there were preparations they ingested for a certain purpose that was actually recommended for another, they also reported being unaware that medicinal plants could cause adverse reactions. According to Pedroso *et al*. (2021), the idea of harmlessness, that "natural is harmless" is a reality for many users. This fact leads to the need and importance of working on this topic in the classroom in order to properly instruct students on the correct use of plants with medicinal properties, as according to Pereira and Cunha (2015), healing through plants is a tradition that spans generations and when used properly, can provide a variety of health benefits, contributing to the cure of various diseases.

In the fourth stage, immediately after the literature review, didactic activities were followed, aimed at contributing to the construction of meaningful learning related to the study of Organic Functions. In this perspective, a contextualized class was taught with medicinal plants, listing the basic characteristics for the recognition and differentiation between the main Organic Functions (alcohol, enol, phenol, aldehyde, ketone, carboxylic acid, ester, ether, amine, and amide). For contextualization, the formulas of the active principles of different medicinal plants were used from those which the students conducted the literature review on, as after the class they would identify the organic functions present in the major active principle of the medicinal plant researched by each of them.

It should be emphasized that the identification and recognition of organic functions were carried out together with the students. In addition to working on the identification of organic functions present in the active principles described, the pharmacological activities caused by the active constituents were also listed, as well as the organoleptic characteristics often derived from these active principles, such as aromas and flavors. An example of this is ginger, which contains active principles such as gingerol and zingerone, responsible for its pungent flavor, as well as therapeutic actions against throat infections, colds, and flu (Conceição, 2013; Ferreira *et al*., 2020).

In the literature review stage, research on the chemical constituents responsible for the pharmacological actions on the medicinal plant was also conducted by the students, as mentioned earlier. Therefore, after the contextualized class, in stage five, each student analyzed their scientific card and recognized the functional groups present in the chemical structure of the major active principle of the medicinal plant, which was consulted in the literature.

It is worth noting that most students attached samples of the medicinal plant to the cards, allowing for a visual/sensory experience, such as aroma and coloration specific to each plant, which were closely associated with organic compounds. The medicinal plant commonly known as Pariri (*Arrabidaea chica*), researched by one of the students, according to Schiozer *et al*. (2012), is a source of flavonoid pigments such as carajurin and carajurone, which are responsible for giving the characteristic reddish color to the plant. Another example of the experience provided was with Capim-Santo (*Cymbopogon citratus*), which presents a citrus aroma from its leaves, which according to Santos (2021) is a result of the major organic compound, citral, an active principle that provides the plant with its calming and spasmolytic action. Therefore, during these two moments, the students showed great involvement and participation, as the research on active principles and the identification of organic functions present brought theory closer to the students' daily lives,

making them realize the presence of Chemistry in their everyday lives, as can be seen from a student's comment: "It's interesting to understand that organic functions are totally linked to the characteristics that plants present, such as their influence on aromas, for example." According to Ricardo (2003), contextualization gives meaning to what is taught to students, helping to problematize knowledge to be taught, consequently arousing students' curiosity and interest in acquiring knowledge.

The students reported difficulties in differentiating the ester, ether, and ketone functions when analyzing the chemical structures of active principles such as carquejyl acetate and coumarins found respectively in carqueja (*Baccharis trimera*) and guaco (*Mikania glomerate*), because these functional classes present a certain similarity that ends up confusing them. Students also had difficulties recognizing the occurrences of organic functions when functional groups are presented in abbreviated form. This fact demonstrates the importance of the teacher resorting to methodological strategies that result in better and more effective student learning.

The compilation of knowledge acquired through successful practices carried out by the participating students resulted in an educational product, an illustrated booklet titled "Medicinal Plants as a Generating Theme for the Study of Organic Functions and Scientific Literacy in Chemistry class." This booklet presents information on 17 medicinal plants acquired through experienced educational practices that favored scientific research and meaningful learning. The cards for each medicinal plant present the main part(s) used for consumption, forms of use, indications, pharmacological action described in the literature, major active principles with their respective chemical structures, organic functions present, contraindications, as well as illustrations containing photos that facilitate the recognition of the plants.

The intention is for this material to serve as support for spreading the correct and safe use of medicinal plants and to contribute to a contextualized and meaningful teaching of Organic Chemistry. According to Maia (2019), among the various ways to promote learning and scientific dissemination, in formal and non-formal environments, is the use of educational materials like this one. According to the author, this type of product is a methodological tool, providing students and educators with the possibility of associating scientific knowledge with popular wisdom.

The elaborated booklet was exhibited physically and digitally accessible via QR Code (FIGURE 7) in the last stage of the intervention. In addition to this, some of the plants and their respective teas were exhibited, constituting a very important moment, which represented the culmination of the activity. At this moment, the students expressed joy at

seeing the medicinal plant used by their families integrating the completed work, as well as being able to feel the aroma and characteristic flavor of some of the plants. The booklet can be accessed through this link: https://drive.google.com/u/0/uc?id=1eVNvVFZk_UoYoXVLDWIrxyQYON7n4u&export=download or by scanning the QR Code displayed in Figure 7.

Figure 7. QR Code card for access to the booklet in digital format

Source: Prepared by the authors

EVALUATING THE DIDACTIC INTERVENTION

At the end of the didactic intervention development, the final questionnaire was administered, aiming to evaluate the acceptability of the methodological approach using the generating theme "Medicinal Plants" and its contributions to the teaching and learning process. The initial question consisted of analyzing what the students found most interesting during the study using the generating theme "Medicinal Plants." From the responses obtained, it was found that the students made references to the existing connection between the theme and Organic Chemistry, as well as the importance of using medicinal plants safely and rationally to avoid adverse effects. Below are some reports from students:

> "What caught my attention the most was the fact that the active principles of the plants in question were intimately related to what we were studying. I had a certain notion that the effects were related to chemistry, but I wasn't sure exactly how that relationship worked." (STUDENT A)
>
> "What I found most important was the relationship between medicinal plants and organic functions, facilitating their study, from understanding to identification." (STUDENT B)
>
> "I learned about the correct usage and it helped me understand organic chemistry." (STUDENT F)

> "We learned about the scientific validation of what we use, as it's passed down through generations." (STUDENT M)

According to Marochio and Olguin (2013), using examples of active principles extracted from plants for the study of organic functions allows for student interaction with the content and their effective participation, valuing common sense and the importance of care regarding the abusive use of plants, as they are medicines. Furthermore, it also provides the opportunity to work on scientific literacy based on the plants used by students and their families.

Seeking to verify possible indicators of Scientific Literacy, the following question was asked again: Do you think the use of medicinal plants can cause any side effects? From the results obtained, everyone answered affirmatively. This shows a change in conception for the 43% of students who initially believed it did not cause any side effects. In parallel, when asked about the precautions that need to be taken for the safe use of these plants, various aspects were mentioned, as follows:

> "First, you need to know the plant and consume it correctly. Then, don't overdo the amount." (STUDENT A)

> "Avoid mixing various species of medicinal plants, observe the dosages of each one, and never collect them near garbage or septic tanks." (STUDENT E)

> "Do not take any medicinal plants during pregnancy, check if the plant is really the one being ingested, use it moderately, and pay attention to possible side effects." (STUDENT J)

It was observed that the students demonstrated using notions of scientific knowledge by pointing out aspects that are extremely necessary to be evaluated before consuming any type of plant for medicinal purposes. According to Colet *et al*. (2015), the safety and efficacy in the use of a medicinal plant depend on correctly identifying the plant, knowing which part should be used, the method of use, use by children, pregnant women, and the elderly, dosage and consumption time, adverse effects, and implications of association with other conventional medications, thus aggregating knowledge from consolidated popular use and evidence revealed by scientific studies.

Therefore, the theme of medicinal plants is interesting within the scope of promoting Scientific Literacy, as it allows students conditions of autonomy, critical reflection, as well as skills and competencies to act in self-care or even as disseminators of evidence-based information demonstrated by scientific research. In this way, knowledge can be socialized, contributing to dissemination for future generations (Pedroso *et al.*, 2021).

In the initial questionnaire, when asked about the existence of any relationship between medicinal plants and Organic Chemistry, 72.4% of the students responded affirmatively and 27.6% negatively. In order to observe any change in the opinion of these students after the implementation of the didactic intervention, the same question was repeated in the final questionnaire. From the results obtained, it was noticed that all students claimed to see Organic Chemistry linked to the theme studied. This result also shows a change in the students' conception who initially couldn't connect Chemistry to medicinal plants. Some phrases that demonstrate such understanding by the students are shown below.

> "Yes, given that the active principles responsible for the medicinal effects are formed by certain functional groups studied in organic chemistry." (STUDENT A)
>
> "Organic chemistry does indeed have a relationship with medicinal plants, considering that the active principle of plants includes various functional groups." (STUDENT B)
>
> "Yes, there is a strong relationship between the study of organic chemistry and medicinal plants." (STUDENT D)
>
> "Many chemical compounds found in medicinal plants are organic compounds." (STUDENT E)

Finally, they were questioned about studying organic functions using the generating theme of medicinal plants, through the following question: Did working on the identification of Organic Functions using "Medicinal Plants" as a generating theme make the content more meaningful and appealing to you? All responded affirmatively, arguing that using the theme to study the content made it more meaningful, due to the use of a theme from their everyday reality, as described in the questionnaire:

> "Yes, as we departed from the routine content of the classroom and approached the subject in a more dynamic way, where we had to research deeply about the plant and its active principle. Thus, identifying the functional groups in plants became more interesting than in the chemical compounds addressed by teachers in class, which are usually unknown and very complex to students." (STUDENT A)
>
> "Bringing things we see and/or use in our daily lives and relating them to chemistry makes learning more interesting and innovative." (STUDENT C)
>
> "It's interesting to study organic chemistry in a way that encompasses everyday life, making it easier to perceive how organic chemistry works and how it affects our lives." (STUDENT D)

According to Lima (2017), the use of methodologies that foster the relationship between what is taught and the learner's daily life, from an approach that awakens the student's perception of the interface between what they already know and what they must

learn, shows greater potential to build meaningful learning, as it generates motivation and interest in the student and attributes meaning to the content.

FINAL CONSIDERATIONS

Didactic proposals that offer the search for new information within the practice and reality of the student are relevant, as they establish an interesting connection between the knowledge acquired through the students' experiences and abstract concepts. In this sense, the more daily life is redirected to educational practices, the more promising the student's engagement with the learning process becomes. Thus, the use of medicinal plants as a generating theme for the study of organic functions and Scientific Literacy evidenced, as shown by the results, how resorting to resources based on contextualization and bibliographic research benefits the educational process.

The study showed that many students, despite having used some medicinal plants, lacked knowledge regarding preparation methods, correct prescription, and necessary precautions for use. Therefore, the activities developed using the generating theme allowed for the integration of scientific knowledge with popular knowledge, reflection on the correct usage, benefits, risks, and precautions during administration. Additionally, the didactic resources employed and the proposed activities throughout the didactic intervention demonstrated to have sparked curiosity and interest among the students, given their active participation in knowledge construction, which may have contributed to the students' processes of scientific teaching and literacy. These results reinforce the importance of addressing cross-cutting themes, such as medicinal plants and scientific literacy in basic education, through methodologies that allow students to actively participate in knowledge construction.

Regarding the study of Organic Functions, it can be observed that the proposed didactic sequence proved to be a good pedagogical tool for working on the recognition of organic functions. Through the methodology used, it was possible to give meaning to the study of organic functions based on a theme from students' daily reality, providing contextualization of teaching and the development of more meaningful learning. Furthermore, there was the creation of an educational product aimed at teaching organic functions, as one of the specific objectives to be achieved.

Therefore, although there are difficulties in further addressing the theme due to the reduction in the weekly class hours for the Chemistry subject in the 3rd year due to the implementation of the new High School system, it proves to be an interesting resource to be

further explored through experimental activities such as active principle and essential oil extraction, visits to community gardens, and stands of herbalists in municipal markets.

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