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*FORMATIVE ITINERARY IN SEARCH OF ENTREPRENEURSHIP: USING
EXPERIMENTAL CHEMISTRY PROJECTS IN A PUBLIC SCHOOL IN THE
STATE OF PARÁ¹*

**ITINERÁRIO FORMATIVO EM BUSCA DO EMPREENDEDORISMO: USO
DE PROJETOS EM QUÍMICA EXPERIMENTAL EM UMA ESCOLA
PÚBLICA DO ESTADO DO PARÁ**

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ABSTRACT

Entrepreneurial education can be understood as a dynamic process involving awareness, reflection, association, and the application of ideas, transforming experience and knowledge into practical and functional results. In this study, laboratory activities and product creation, such as soaps, ointments, and herbal shampoos, were developed using natural ingredients from the Amazon region. The objective was to bring students closer to practical chemistry and entrepreneurship, strengthening skills such as innovation, responsibility, and environmental awareness. The project was divided into stages of training, product development, exhibition, and promotion, incorporating chemistry concepts and

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fostering learning incentives. Finally, a questionnaire with open and closed questions was administered to assess students' knowledge of the activities conducted. The results showed good acceptance of the proposal, as well as engagement and understanding of the relevance of chemical knowledge for the job market, highlighting the transformative potential of chemistry education allied with entrepreneurship. entrepreneurship.

Keywords: entrepreneurship, herbal products, chemistry.

RESUMO

A educação empreendedora pode ser entendida como um processo dinâmico que envolve conscientização, reflexão, associação e aplicação de ideias, transformando a experiência e o conhecimento em resultados práticos e funcionais. Neste trabalho, foram desenvolvidas atividades laboratoriais e de criação de produtos, como sabonetes, pomadas e shampoos fitoterápicos, com ingredientes naturais da região amazônica. O objetivo foi aproximar os estudantes da química prática e do empreendedorismo, fortalecendo habilidades como inovação, responsabilidade e consciência ambiental. O projeto foi dividido em etapas de capacitação, elaboração de produtos, exposição e divulgação, incorporando conceitos de química e promovendo ações de incentivo ao aprendizado. Por fim, foi aplicado um questionário contendo perguntas abertas e fechadas para avaliar o conhecimento do público estudantil sobre tais ações desenvolvidas. Os resultados mostraram uma boa aceitação da proposta, além de engajamento e compreensão da relevância do conhecimento químico para o mercado de trabalho, destacando o potencial transformador do ensino de química aliado ao empreendedorismo.

Palavras-chave: empreendedorismo, fitoterápicos, química.



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INTRODUCTION

In recent years, Brazilian education has been the focus of intense debates about the need for structural changes in the guidelines that shape school curricula. The National Common Curricular Base (BNCC) is presented as a normative document that outlines the essential learning that must be guaranteed to all students in the country:

The National Common Curricular Base (BNCC) is a normative document that establishes a cohesive and progressive set of fundamental learnings that all students must acquire throughout the stages and modalities of Basic Education, thus ensuring respect for their rights to learning and development, in accordance with the guidelines established by the National Education Plan (PNE) (BRAZIL, 2015).

The purpose of the BNCC is to facilitate more effective articulation between theory and practice, generating a positive impact on the education of young people across the multiple social, personal, economic, and professional dimensions of their lives. In this way, it seeks to ensure quality education that prepares students for the challenges of the contemporary world.

According to the BNCC, competence is the ability to use knowledge, skills, and values to deal with complex everyday situations, exercise citizenship, and prepare for the job market. Therefore, it is essential that schools be organized to offer the necessary tools - both cognitive and material - that allow young people to take an active role in their own learning. Schools must thus be prepared to provide both cognitive and material support, enabling youth protagonism. According to the BNCC, it is essential to create spaces and curricula that foster this development by cultivating attitudes, skills, and values that encourage entrepreneurship, such as creativity, innovation, organization, planning, responsibility, leadership, collaboration, future-oriented thinking, willingness to take risks, resilience, and scientific curiosity. These competencies are



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fundamental for personal development, active citizenship, social inclusion, and employability (BRAZIL, 2015).

In this context, it is observed that areas of knowledge are increasingly oriented toward teaching approaches and methodologies that prioritize the development of students' competencies and skills. These practices include diverse activities that encourage both students and teachers to build a more meaningful and relevant teaching–learning relationship. Santos (2023) emphasizes that entrepreneurial education promotes a form of teaching that seeks to awaken in students not only the capacity for creation and innovation but also the ability to face challenges with a critical and transformative worldview. This concept is linked to the idea that education can, in fact, prepare individuals to become agents of social and economic change by developing strategies that benefit the community.

Currently, entrepreneurship has been gaining increasing prominence in Basic Education in Brazil, impacting both pedagogical practices with students and the professional training of teachers (Dolabela, 2003). Moreover, although its introduction is recent and challenging, entrepreneurship plays an important role in forming individuals capable of transforming the environment in which they live, aiming at the common good. In this context, the school is fundamental, as it is through it that entrepreneurial education can stimulate creativity, the desire for personal growth, and the ability to use the environment to foster social and economic development (Amorim, 2018).

Entrepreneurial education can be described as one that allows students to recognize themselves as part of a specific problem, enabling them to analyze the situation and seek the information and resources needed to solve it, using previously planned and evaluated strategies (Souza et al., 2004). According to Schaefer and Minello (2017), entrepreneurship goes beyond conventional learning methods, representing a way of learning that involves the development



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of competencies such as communication, creativity, opportunity recognition, critical thinking, leadership, and decision-making. The development of this set of skills highlights the importance of lifelong education, seen as an individual and continuous process of pursuit (Henrique; Cunha, 2008; Frolova et al., 2019).

Scientific Initiation (SI), both in higher education and in basic education, aims to encourage vocation and the emergence of new research talents (Santos, 2011). In this context, the participation of young people in the academic-scientific environment through PIBIC-EM scholarships (Institutional Scientific Initiation Scholarship Program for High School) contributes to reducing the gap between Basic Education (BE) and Higher Education (HE). In the program, students have the opportunity to explore laboratories, participate in experiments, learn how to search for information in scientific databases, improve their language skills, and interact with undergraduate students and professors, in addition to gaining a deeper understanding of the professions in the field in which they may work in the future.

The relationship between chemistry teaching and the development of creative skills - such as the ability to create, produce, and transform - is frequently discussed in various studies on education. As highlighted by Neiva (2013), the importance of connecting theoretical content with students' reality is fundamental for more meaningful learning. In this regard, the inclusion of projects that engage high school students in activities - through training initiatives and outreach projects - can be extremely enriching for the development of creative skills and the construction of more active learning. When students have the opportunity to explore content beyond the classroom and apply it in other environments, they are able to visualize the practical possibilities of what they have learned, connecting theoretical knowledge with real and innovative applications.

This approach not only sparks interest in science but also encourages problem-solving abilities and critical thinking, qualities that are fundamental for



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personal and professional development. Furthermore, by experiencing the routine of research and laboratory practice, these students become more prepared and motivated to pursue scientific and technological careers, contributing to the training of new researchers and to the advancement of science in the country.

In light of this, this study aims to promote entrepreneurial education in a public school in Cametá-PA, motivating students through experimental activities such as mixture separation, extraction of natural products, and the preparation of herbal products (shampoos, ointments, and soaps). Through this practical and interactive approach, the goal was to develop entrepreneurial skills in students - such as innovation, responsibility, and environmental awareness - by integrating theory and practice in a transformative educational environment.

METHODOLOGY

This work employs a mixed-methods approach (qualitative and quantitative), descriptive and exploratory in nature. According to Creswell (2010), the combination of both methods strengthens the mixed methodology, highlighting the advantages of both qualitative and quantitative approaches. Silva and Simon (2005) argue that quantitative research is more appropriate when there is prior knowledge and control over the object of study. In contrast, Silva, Lopes, and Braga Júnior (2014) observe that qualitative methods are geared towards little-explored areas, with the aim of obtaining empirical information about reality. The study was conducted through the Institutional Program for Scientific Initiation Scholarships (PIBIC) project in partnership with a full-time high school in the municipality of Cametá-PA, called E.M.T.I Abraão Simão Jatene. Thus, a didactic sequence could be adopted to achieve the proposed objectives, which occurred in three stages: 1) Training: entrepreneurial education and the teaching of chemistry; 2) Product Development; 3) Product display.



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Training: entrepreneurial education and the teaching of chemistry

The first stage, dedicated to introduction and awareness, aimed to present the concepts of entrepreneurial education and its relevance to chemistry, with a focus on practical and sustainable applications. The activities included introductory lectures on scientific entrepreneurship, highlighting the importance of entrepreneurial education in chemistry and its relationship with the development of natural products and environmental impact. In addition, case studies were conducted using real examples of entrepreneurs who created sustainable chemical products, such as herbal medicines and natural cosmetics. In this stage, the goal was to develop skills such as scientific curiosity, understanding of environmental impact, critical thinking, and market awareness.

The following stage focused on the development of technical and experimental knowledge and aimed to teach the practical and theoretical foundations of chemistry applied to product creation. The activities included experimental laboratory sessions with practices for extracting active compounds from plants. In addition, classes were offered on specific chemical processes, such as saponification and emulsification, which are essential in the production of cosmetics and herbal products.

Product development

In the second stage, prototypes and products were developed with the aim of applying the learned concepts to create prototypes of chemical products. Activities included the creation of natural products such as moisturizing soaps, ointments, and shampoos with natural ingredients. The developed products followed the preparation methodology (Chart 1) derived from the work carried out by COOPEMUC (Agroindustrial and Extractive Cooperative of Women of the Municipality of Cametá), where women from the islands of the municipality



produce and market products derived from extractive activities and agroecological management through the manipulation of medicinal plants (Belém et al., 2023). Furthermore, it helps to ensure income generation and access to the market in a fair and supportive way, strengthening the local economy and encouraging sustainable practices that benefit the community as a whole.

Chart 1: materials and procedures for manufacturing the products.

PRODUCTS	MATERIALS	PROCEDURES
Homemade moisturizing soap making	450 g of glycerin; 25 mL of andiroba oil; 50 mL of aloe vera; 2.5 mL of essence, for each portion of product and group of participants; Silicone molds;	Melt the glycerin in a double boiler, then remove from heat and add olive oil, aloe vera, and then the essence. Next, divide the resulting material into silicone molds.
Homemade andiroba and copaiba ointment	250 g of vegetable fat; 150 mL of andiroba oil; 50 mL of copaiba oil; 5 tubes of 60 mL and 5 of 30 mL.	Melt the vegetable fat in a double boiler. Once melted, turn off the heat and mix with the other ingredients. Pass through a small, fine sieve (note: vegetable shortening sometimes has impurities, so it's important to filter it). Then fill the squeeze bottles.
Homemade fortifying shampoo making	1 L and 50 mL of water; 50 g of green jaborandi; 30 g of green love-in-a-mist; 100 mL of peeled aloe vera; 5 mL of rose or jasmine essence; 250 g of coconut bar; Tubes;	Place the well-washed leaves in boiling water and leave for 10 minutes, with the pan covered and over low heat. Then turn off the heat and let it cool slightly. Next, strain (filter) the herbs and squeeze with a glove. Next, grate the coconut soap directly into the pan to melt it, then return it to the heat until it is completely melted. Next, mix it with the aloe vera and, lastly, the essence. Measure the contents to 100 ml (yield), strain it once more through a fine stainless steel sieve, and fill the squeeze bottles sanitized with a hypochlorite solution (bleach).

Source: COOPEMUC (Cooperativa Agroindustrial e Extrativista das Mulheres do Município de Cametá).

Product display

In the third stage of the project, an exhibition of the developed products was held at the 1st Entrepreneur Fair of UEPA/Cametá, where the different



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phases of the project, the products developed, and the phytotherapeutic benefits associated with each one were presented to teachers, students, and other participants. In addition, a presentation was given at the E.M.T.I Abraão Simão Jatene school to the 2nd-grade class, with the aim of demonstrating to the students the development of the project, the skills, and the knowledge acquired throughout its execution. After the presentation, a questionnaire (Chart 2) was administered to the students with objective and open-ended questions related to the activities carried out in the project in order to understand the students' comprehension of the knowledge constructed from the process undertaken.

Chart 2: Description of the questions in the questionnaire given to high school students.

- | |
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| <p>1 - Can you see how knowledge in chemistry can open doors to entrepreneurship? a) Yes
b) No</p> <p>2 - Did the learning pathway proposed in the project spark your interest in exploring chemistry in a practical and entrepreneurial way? a) Yes b) No</p> <p>3 - Do you believe that this type of approach, which combines experimental chemistry with entrepreneurship, can create professional opportunities for young people? a) Yes b) No
c) Maybe</p> <p>4 - Does the proposal to create products such as natural soaps or ointments help you envision an entrepreneurial career? a) Yes b) No c) I don't know</p> <p>5 - Do you think you could turn this knowledge into a business? a) Yes b) No c) Maybe</p> <p>6 - Did this entrepreneurial approach change your view of chemistry teaching? a) Yes b) No c) I don't know</p> <p>7 - What did you think of the project? a) Excellent b) Good c) Fair d) Poor</p> <p>8 - Would you like to participate in a similar project where you can connect chemistry knowledge with the creation of a product or business? a) Yes b) No c) Maybe</p> <p>9 - How does entrepreneurial education contribute to the development of high school students?</p> <p>10 - How can the production of herbal products promote sustainability and local entrepreneurship in the Amazon?</p> |
|--|

Source: Elaborated by authors.

RESULTS AND DISCUSSIONS

The results obtained throughout the project stages indicate significant progress both in learning chemical concepts and in developing the students' entrepreneurial and scientific skills.



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Training: entrepreneurial education and the teaching of chemistry

The first stage, focused on introduction and awareness, proved to be essential in sparking students' interest in entrepreneurial education applied to chemistry. As reported by Soares et al. (2020), the introduction of scientific entrepreneurship concepts in chemistry teaching contributes to the development of a critical and innovative perspective among students. This result is reinforced by the active participation of students in the lectures and case studies, demonstrating an increased understanding of the environmental impact of chemical products and a growing interest in the development of sustainable products.

In the technical and experimental development stage, it was observed that the laboratory activities provided significant progress in understanding specific chemical processes, such as the extraction of active compounds from plants, saponification practices, and emulsification, as shown in Figure 1. Camarão et al. (2020) highlight that experimental activities are essential for motivating students to continue their studies, as they offer a form of learning based on practice and active participation. By engaging directly with experiments, students acquire knowledge autonomously, "getting hands-on" and building their skills independently.

Figure 1: Figures A and B show the students during the training.



Source: Authors, 2024.



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Product development

The second stage of the project, dedicated to the development of prototypes and products, proved effective in consolidating the learning of theoretical concepts through practice and the creation of natural products such as moisturizing soaps, ointments, and shampoos made with sustainable ingredients. This process allowed students to apply their knowledge in a real context, following the sustainable production methodologies used by COOPEMUC. The methodology developed by COOPEMUC, based on extractivism and agroecological management, served as inspiration for students to develop products with natural ingredients and low environmental impact, demonstrating the feasibility of sustainable solutions in the field of chemistry (Belém et al., 2023).

In addition to increasing students' engagement and sense of responsibility, this sustainable approach reinforces the role of chemistry in promoting environmentally sound and socially just practices. The products created at this stage not only enriched students' technical learning but also reinforced concepts of social entrepreneurship. Based on the use of medicinal plants, the project inspired students to value local natural resources and to understand the economic benefits that can result from fair and cooperative production practices. Social entrepreneurship in Brazil emerges as a response to social and economic challenges, promoting sustainable and equitable practices that value local natural resources (Oliveira, 2020).

Product display

In the final stage of the project, the products were exhibited at the 1st Entrepreneur Fair of UEPA/Cametá and presented at the E.M.T.I. Abraão Simão Jatene school, as shown in Figure 2. This stage proved effective in disseminating the acquired knowledge and strengthening the educational and social impact of



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the project. The fair provided a space where teachers, students, and other participants could explore each phase of the project, visualize the developed products, and understand the phytotherapeutic benefits associated with each one, which generated interest and engagement from the public. This direct exchange reinforced the relevance of sustainable practices and entrepreneurship in chemistry, bringing the local community closer to the possibilities of innovation in the development of natural products.

Figure 2: Figures A and B show the exhibition at the 1st Entrepreneur Fair of UEPA/Cametá, and C and D show the presentation at the school.



Source: Authors, 2024.

The presentation to the students was a valuable opportunity to inspire new participants to engage in similar projects, as well as to allow the sharing of the skills and knowledge acquired throughout the process. By making the development process and its practical applications more visible, the students involved in the project were able to illustrate how entrepreneurial education and chemical knowledge connect with real life, encouraging scientific curiosity and appreciation for environmentally responsible products.

After the presentation, the questionnaire administered to the students revealed a satisfactory level of understanding of the concepts and practices



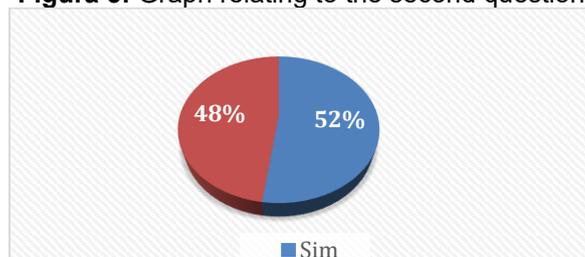
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addressed in the project. Regarding question 1, when asked about their ability to visualize entrepreneurship in chemistry, 91% of the students showed some understanding of this practice and how school knowledge can help them enter the job market, especially through innovative practices that can emerge within the school environment itself. However, 9% of the participants responded negatively. This result suggests that there is still a group of students who do not clearly perceive this relationship, indicating the need to reinforce practical applications and the innovative potential of chemistry in order to promote a broader understanding of entrepreneurial opportunities in the field. Studies conducted by Alvarez (2001) help explain this perspective, pointing out that having these initial notions about the importance of entrepreneurship is essential for developing a unique awareness of opportunities, the ability to generate ideas, and the capacity to organize oneself in the face of possibilities.

Regarding question 2, the results showed a nearly even split: 52% of participants answered “Yes,” while 48% answered “No,” as shown in Figure 3. These data suggest that although the project sparked the interest of more than half of the students, there is still a significant portion who did not feel motivated to explore chemistry from this perspective. These results indicate the need for adjustments in the approach to make the topic more accessible and engaging for all students. Carminatti (2022) emphasizes that “the implementation of learning pathways must be continuously adjusted to meet the diverse needs and interests of students, promoting a more inclusive and engaging learning environment.”

Figura 3: Graph relating to the second question.



Source: Authors, 2024.



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With regard to question 3, 48% answered “Yes” and 52% “Maybe.” Combining experimental chemistry with entrepreneurship can become a promising idea for opening doors for many students. Lopes (2010) emphasizes the importance of educational practices that encourage students to “learn by doing.” According to the author, it is at this moment that students apply the knowledge acquired throughout their lives in order to take action. Through trial and error, they build a viable path through practical and experiential activities that lead them to action and reflection, making them builders of their own learning - an essential characteristic for entrepreneurship.

Regarding question 4, creating products from natural plants proved to be a highly effective proposal for envisioning an entrepreneurial career, with 96% of participants answering “Yes” and only 4% “No.” According to Amorim (2018), entrepreneurial pedagogy in Brazilian basic education has the potential to transform the environment in which we live by promoting creativity and innovation among young people.

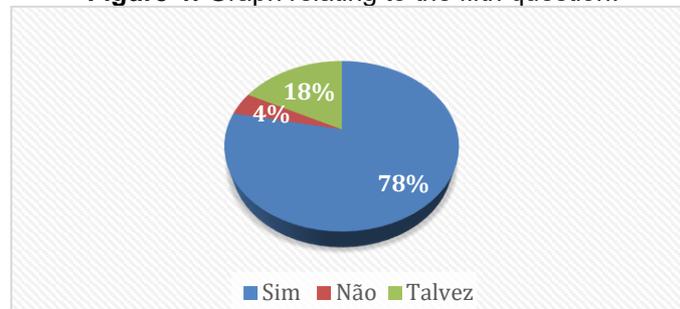
Concerning question 5, about entrepreneurial potential, 78% responded “Yes,” 18% “Maybe,” and 4% “No,” as shown in Figure 4. Araújo et al. (2005) discuss the importance of entrepreneurship in chemistry education, highlighting that training entrepreneurial chemists opens a wide range of possibilities for the practical application of knowledge, fostering innovation and the creation of sustainable businesses. This reinforces the importance of initiatives that connect scientific education with the business world, preparing young people for today’s job market.



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Figure 4: Graph relating to the fifth question.

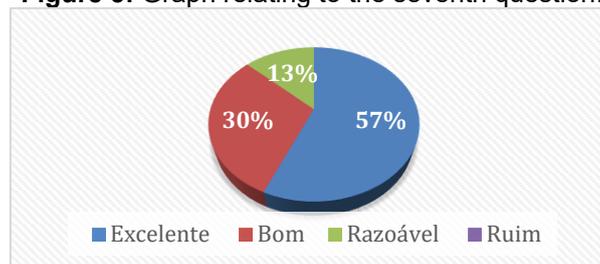


Source: Authors, 2024.

Regarding question six, about the entrepreneurial approach, 52% answered that “Yes,” it impacted their view on this approach in chemistry teaching, while 39% said they didn’t know and only 9% said “No.” According to Souza and Pereira (2019), the introduction of entrepreneurial concepts into the chemistry curriculum not only sparks students’ interest but also prepares them to innovate and face challenges in the job market.

The results showed that 57% of respondents considered the project “Excellent,” 30% “Good,” and 13% “Reasonable.” Regarding question 7, this result demonstrated that the project managed to highlight its relevance, given that no negative responses were obtained in this question, as shown in Figure 5.

Figure 5: Graph relating to the seventh question.



Source: Authors, 2024.

Regarding question 8, 39% responded that they would participate in a project similar to the one presented, 35% “Maybe,” and 27% opted for “No.” This indicates that many students were interested in integrating knowledge of chemistry with entrepreneurship. The school, seen as an environment of diverse



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cultures, should promote and value the culture of identifying opportunities. Students need to be proactive and decisive in building their future, recognizing and taking advantage of present and future opportunities. Therefore, the school environment should be conducive to the flourishing of the entrepreneurial spirit and for students to develop their profile through experiences in different scenarios (Oliveira et al., 2014).

Regarding question 9, which was open-ended, students expressed diverse perspectives on how entrepreneurial education can contribute to the training of young people in high school:

“Entrepreneurship contributes significantly because it promotes creativity, critical awareness, and a positive experience in shaping the future” (Student 1).

“In many ways, primarily through financial income and knowledge. With all this knowledge, a person can create their own business and grow in the financial market” (Student 2).

“It plays a fundamental role in our development, equipping us with the necessary tools to face challenges” (Student 3).

In light of these responses, it becomes evident what Dolabela (2003, p. 24) highlights in his studies, stating that "the entrepreneurial spirit is a potential of any human being and requires some indispensable conditions to materialize and produce effects." The author reinforces the idea established by the students that entrepreneurship is present in every person and that it needs projects like the one brought to the classroom to awaken this spirit that has dreams and seeks fulfillment, especially financial fulfillment.

Regarding question 10, which was also discursive, the students presented various opinions on how the production of phytotherapeutic products can foster sustainability and local entrepreneurship:

“It helps with sustainability because the products are extracted from nature, but in small quantities and without harming the environment, in addition to contributing to entrepreneurship in the Amazon, by using local products” (Student 4).



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"In this way, it will not be as aggressive towards nature as many companies do, using various chemical products" (Student 5).

The students' reflections were satisfactory for this research, as they indicate that they understood the need to create products that contribute to sustainable development. Furthermore, it was evident that entrepreneurial ideas, which can be implemented by themselves, have the potential to preserve local fauna. In this sense, according to Nassif (2002), "an individual only knows something when they interact with that something." In this way, individuals have different histories because they interact with the environment in different ways. Thus, promoting this project with a sustainable approach was essential for students to understand the importance of sustainable entrepreneurship.

Given this scenario of responses, it is clear how important it is to establish the union of science with entrepreneurship, as it stimulates the students' perception of the indispensability of putting into practice ideas that are on this perspective of entrepreneurship, thus, future professionals will be trained with skills that will stand out in the job market.

CONCLUSION

Based on the analysis of the results, it is possible to affirm the importance of integrating experimental chemistry and entrepreneurial education as an effective strategy for developing skills relevant to the job market and for civic education. The activities developed at the school showed that chemistry teaching can go beyond theoretical content, stimulating creativity, a sense of responsibility, and environmental awareness among students, especially when exploring natural resources of the Amazon. The students demonstrated great engagement and understanding of the concepts, which highlights the transformative potential of active and applied methodologies. This type of initiative not only brings young people closer to science and innovation but also empowers them to create



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sustainable and socially just solutions, encouraging them to act as agents of change in their communities. In this way, basic education assumes a central role in preparing future professionals with a critical and entrepreneurial vision.

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