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The “hair straightening” theme as a didact proposal for teaching biochemical concepts

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ABSTRACT

Considering the importance of knowledge about science and how they help for an active and responsible participation in today's society, this study aimed to verify the prior and subsequent knowledge of the didactic proposal on the subject of hair, evaluating the understanding of concepts related to proteins, amino acids and oxidation-reduction reactions. Twenty-seven students from the 5th semester of the Licentiate Degree in Natural Sciences participated in this research. The didactic proposal was applied using an expository class and a demonstrative experiment, and evaluated through a questionnaire before and after the proposal. In the result of this study, it was detected that students had difficulties with specific concepts of proteins, which was demonstrated by the lack of clarity in the development of responses. However, when questioned through chemical concepts related to daily life, satisfactory results were obtained. Finally, part of this work corroborates the effectiveness of thematic activities combined with everyday issues, confirming data already present in the literature. However, more studies are needed to meet the demand for understanding scientific concepts of biochemistry, since, in this context, the present proposal has not demonstrated its effectiveness in its entirety.

KEYWORDS: Proteins. Amino Acids. Science teaching.

INTRODUCTION

Within the fields of knowledge of Chemistry and Biology, Biochemistry makes it possible to relate the knowledge of molecular structures and interactions in the understanding of the functioning of living organisms, being an interdisciplinary area (SILVA *et al*., 2017). One of the bases for studying Biochemistry are biomolecules, and among them the proteins that are the most abundant in living beings, as they have a structural and functional variety, and their importance is related to the catalysis of biochemical reactions, transport, tissue structure, the immune system and hormonal regulation (MOTTA, 2003; NELSON, 2002; CAMPBELL, 2000).

For the understanding of biomolecules, capillary chemistry and aesthetics is an everyday topic that allows us to approach these concepts, due to the complexity of their constitution. Thus, this becomes a matter of importance, which demands scientific knowledge so that one can interpret the problems that involve it. Educational activities should focus on situations of experience where the student's natural potential, capabilities, needs and interests are activated (LIBÂNEO, 1994).

This work presents an approach to the theme "hair straightening" associated with the syllabus of the discipline entitled "Fundamentals of Metabolism" in a 5th semester class of a degree course in Natural Sciences at a federal university located in the state of Rio Grande do Sul.

From the knowledge of proteins, the capillary structure and the aesthetic smoothing procedure, a didactic proposal was developed based on the pedagogical characteristics summarized by Marcondes (2008), as an alternative to traditional teaching. These features include:

> [...] the use of students' experiences and day-to-day facts to organize knowledge and promote learning; approach of Chemistry contents from relevant themes that allow the contextualization of knowledge; establishment of links between Chemistry and other fields of knowledge necessary to deal with the subject under study (MARCONDES, 2008, p. 68-69).

Given the above, the following research question was elaborated: Can hair straightening thematic contribute to the understanding of concepts of proteins and amino acids for undergraduate students in Nature Sciences?

Thus, the didactic intervention was planned with the elaboration of a thematic workshop with the use of scientific concepts of proteins, amino acids and oxidation-reduction reactions, approaching the hair straightening procedure with the use of expository classes and demonstrative experimentation. Thus, this work aimed to detect the previous conceptions of students in the 5th semester of Nature Sciences - Degree on hair straightening; verify the establishment of relationships between biochemical concepts and the aesthetic smoothing procedure and, finally, analyze student learning in relation to scientific concepts and thematic.

GENERAL CONCEPTS AND LITERATURE REVIEW

Science Teaching is influenced by scientific and technological development. After World War II, science and technology became a huge socioeconomic undertaking making them popular at different levels of education. From then on, conceptions of how to teach Science began to emerge. In the 1960s, cognitive theories arrived in Brazil, which consider knowledge to be a product of man's interaction with his world and emphasize students' mental processes during learning.

Some theories suggested that students should deal directly with materials and carry out experiences to learn in a meaningful way and that the teacher should not be a transmitter of information, but a guide for teaching and learning (NASCIMENTO *et al*., 2010).

Although there are many movements aimed at scientific literacy, the precariousness of training for young Brazilians is part of a much broader problem. Data from the Functional Literacy Indicator (INAF) show that 27% of the people surveyed (the sample is stratified with allocation proportional to the Brazilian population in each region) were classified as functionally illiterate, that is, they cannot perform simple tasks involving word reading and sentences, but most (42%) were classified as an elementary group, in which they read one or more information units in medium length texts (INAF, 2016).

Thus, several studies about differentiated practices and methodologies emerge with the purpose of assisting in the Teaching of Science and other areas of knowledge, including teaching through themes.

In Chemistry teaching, activities that result in the memorization of contents and concepts disconnected from the daily lives of students are generally prioritized. Although many researches in the area (SILVA 2017; MARCONDES, 2010; WARTHA *et al*., 2005;) recommend the relationship of Chemistry contents with everyday aspects, this is not a common practice both in schools and universities. Currently, there is a need to move towards a way of teaching that is more problematizing and consistent with the students' reality (PAZINATO; BRAIBANTE, 2014).

The use of themes in the teaching of Chemistry is a viable alternative to achieve this purpose. The development of scientific concepts through themes that are, at the same time, attractive and original, arouses greater interest on the part of students, as it favors the dialogue between Science and the subject, breaking away from fragmented teaching.

According to Marcondes (2008), the thematic approach in the teaching of Chemistry is not understood as just a pretext for the presentation of chemical contents, it is about addressing data, information and concepts so that one can know the reality and propose ways to intervene in the society.

Thematic workshops are based on contextualization and experimentation, where the student can understand and apply a concept. Originally, the workshops proposed by Marcondes (2008) are structured based on the pedagogical moments indicated by Delizoicov and Angotti (1991): initial problematization, knowledge organization and knowledge application.

The initial problematization occurs when students are presented with real situations in their daily lives, whose objective is to make them feel the need to acquire new knowledge to understand them. In the organization of knowledge, the concepts needed to understand the themes and the initial problematization are systematically studied, and the third moment that is defined by the application of knowledge systematically addresses the knowledge that has been acquired by the student, so that he can reinterpret the proposed problem and establish relationships between the knowledge acquired with other problematic situations. (SILVA *et al*., 2014).

The choice for the theme "hair straightening" is justified by the proximity to the student's daily life, and also by the growing use of hair cosmetic procedures, among which the straightening and hair coloring/discoloring stand out. There is an estimate that 60% of Brazilians use or have used some type of straightening and one of the most used cosmetics is hair dye (IBOPE, 2013).

Understanding how these products act and knowing their chemical constituents becomes extremely important. The chosen theme favors multiple approaches, as it makes it possible to work on various scientific concepts in a way that speaks to the student's daily life. As examples, we can cite articles found in the literature that bring this theme associated with the teaching of chemistry (SOUZA *et al*., 2008; KÖLHER, 2011; OLIVEIRA, 2013).

Since ancient times, hair has been impregnated with symbologies, but the art of hair care reached its apex with the Egyptians about five thousand years ago. At this time, the sophisticated wigs of the pharaohs appeared and hairdressers gained prestige in the Egyptian court (KOHLER, 2011).

Until today, hair represents vanity and self-esteem for many people, so promoting these discussions in the school environment can provide a scientific understanding of the theme "hair straightening", associated with aesthetic issues.

Human hair is a set of strands that grow approximately 1.0 to 1.5 cm per month, constantly renewing itself. Its development starts from the third month of fetal life. Hair fibers are basically made up of proteins (95%) and keratin is present in the greatest amount (BORGES *et al.*, 2016).

Human beings have an average of 90 to 150 thousand hairs on the scalp and there is a loss considered normal, 50 to 100 hairs per day. The wire diameter can be changed according to the genetic load (FRANÇA, 2014). The ethnic differences of hair generally depend on the cross-section and how it will grow, that is, the dimension and curve that determine the profile of each hair. A round cross section usually results in straight hair and if it is flat or oval it results in curly or wavy hair (KOHLER, 2011).

The strand of hair grows from follicles located below the scalp. It is the only renewable structural tissue that does not have scars, that is, it is constantly renewed and any changes in shape or texture are temporary, as these changes only affect the hairs that are located outside the follicle. For this reason, hair can be subjected to procedures that could not be supported by any other organ in the human body (MELLO, 2010).

Chemical elements such as iron, copper, zinc, iodine, cobalt and aluminum are present in hair. At a submicroscopic level are the proteins that make up the hair, formed by monomeric units called α-amino acids that are joined together by

peptide bonds. There are 21 different standard amino acids gathered in infinite combinations that enable the formation of different structures (MOTTA, 2003). There are no records of amino acid differences regarding the ethnic origins of the hair, the characteristic of the hair is associated with a great variety of proteins and where they are located in the hair (MELLO, 2010).

Proteins organize themselves in the form of two coiled coils forming microfibrils, which unite to form larger structures and produce the cells of the cortex. When the hair is straightened, the curl provides elasticity and strength, so it is possible to subject the hair to aesthetic straightening or curling procedures.

The first steps towards hair straightening as we know it today started in the 20th century with CJ Walker when he used a heated metal comb and oiled it, in this way it was possible to give shape to the hair. It is noticed that this method is still used, but the comb was replaced by hair dryers and heating boards, the water plays the role of the oil, because the moistened hair becomes elastic and can reach a smooth shape and when completely dry, it keeps the form until the next wash (FERREIRA, 2015 *apud* ZVIAK, 2005).

There are two categories of hair straightening: temporary and permanent. Temporary straightening is a mechanical process that employs heat. The primary agent needed is water which will plasticize the hair, straighten it and when dry it will maintain its shape. When hair is wet it absorbs an amount of water equivalent to about 30% of its weight, with the absorption many weak bonds are broken, promoting swelling and swelling.

Brushing is one of the techniques used to straighten hair through tension and heat. Permanent straightening consists of the chemical reduction of the hair's disulfide bonds, where an alkaline agent with subsequent neutralization of the hair with the new conformation or using the reduction/oxidation technology based on the use of thiols (FRANÇA, 2014).

The so-called definitive chemical straightening began to appear in the 50s, made from caustic soda (NaOH), then came the sulfides and thioglycolates that reduce the pH, preserving the alkaline system, maintaining the reduction process necessary for straightening.

However, the damage to the hair was terrible, with products based on keratin, all imported. In order to minimize this damage, salons started to offer relaxation, which is a kind of weaker straightening, it only removes hair volume, but does not straighten it completely (KÖHLER, 2011).

To change the structural shape of hair, it is necessary to temporarily or permanently break the chemical bonds that keep the keratin molecule in its original rigid form. The chemical bonds that need to be broken are disulfide bonds, hydrogen bonds, ionic bonds and Van der Waals forces (ABRAHAM, 2009).

For a temporary modification of the strand of hair, weak interactions are broken using water and heat. For a permanent change in the shape of the strands, it is necessary to change the number of disulfide bonds, salt and hydrogen bonds, making the hair fiber deformable. Both the straightening and the permanent undulations involve identical chemical processes, what makes the difference is the new shape that will be given to the threads. In order for the wire to stabilize, it is necessary to rebuild the disulfide bonds.

Straightening with alkaline agents as active ingredients are used for relaxation techniques, sodium or potassium hydroxide or sodium carbonate combined with guanidine in a concentration of 1.5 to 3% reduces the amount of cystine to two thirds of the original amount.

Thioglycolate is also used as a straightener, acting on the hair as it is brushed. The cream's viscosity helps to maintain the yarn's conformation during the process. To rebuild the disulfide bonds, a neutralizing agent (pH 8.0-10.0) is applied with an oxidizing agent to eliminate the residual reducing sulfite (DIAS, 2004).

Permanent deformation is obtained by the rupture of disulfide bonds (reducer), salt and hydrogen bonds, which makes the fiber momentarily plastic, that is, deformable without elasticity. Next, you need to rebuild the disulfide (oxidant) bonds to fix them into the desired shape. This is how the keratin and hair chains break their cohesion (MELLO, 2010).

In general, consumers do not know the chemical constituents of products or their inadequate use, components such as formaldehyde, formaldehyde, glutaraldehyde, among others, are the most associated with progressive brushes, subjecting those who seek these procedures to serious risks.

The use of formaldehyde and glutaraldehyde in straighteners result in serious health risks, such as: irritation, pain and burns to the skin, injuries to the respiratory tract and irreversible damage to the eyes and hair (KÖHLER, 2011). There are chemical products that cannot be used together, as this would cause severe damage to the hair, such as hair breakage, excessive pH decrease that prevents water from entering the hair fiber causing extreme dryness, unwanted change coloring, among others.

METHODOLOGY

The research subjects were students from the 5th semester of a Licentiate Degree in Natural Sciences at a federal university located in the state of Rio Grande do Sul. Twenty-seven students who were studying or had already taken the course in Biochemistry participated, 26 of which were female and 01 male.

As for the approach, this research is qualitatively characterized, as the subjectivity of the research subjects is valued through observation and the material that will be obtained during the performance of the activities. In addition, it has the natural environment as a direct source of data and the concern with the process is much greater than with the product (LÜDKE; ANDRÉ, 1986).

The research is characterized as exploratory, as it aims to provide greater familiarity with the problem, with a view to making it more explicit or building hypotheses. In addition to its flexible planning, allowing the consideration of the most varied aspects related to the studied fact (GIL, 2002).

A didactic proposal was elaborated using the theme "hair straightening", structured in the pedagogical characteristics summarized by Marcondes (2008), where the themes are addressed in a way that contextualizes with the scientific concepts, as described earlier in this text. To this end, the following topics of Biochemistry were addressed: proteins, amino acids, chemical bonds (disulfide bonds, hydrogen bonds, ionic bonds and peptide bonds) and oxidation/reduction.

Four hours/class were used for the application of the thematic workshop. Chart 1 lists the activities developed and the methods used:

Chart 1 – Description of activities developed

Activities	Description
- Presentation of the academic and the proposal to be developed; - Delivery of the consent form;	Delivery of the consent form to academics to participate in the research.
- Application of the pre-test (Chart 2); - Video about hair structure;	Completion of the prior knowledge questionnaire on the topic to be addressed and, soon after, the video on the physical and chemical structure of hair.
- Expository class; - Study of the capillary structure (cuticle, cortex and medulla); - Chemical structure of keratin (chemical bonds and amino acids); -The chemistry behind straightening (disulfide bridges, H bonds, ionic bonds, oxidation and reduction); - Demonstrative experiment, through photographic records; - Post-test	Slide show on the structure of hair fiber in its physical form and chemical composition. From this exhibition, the chemical structure of keratin was approached so that students could understand the smoothing process presented in slides and in the form of a demonstrative experiment.

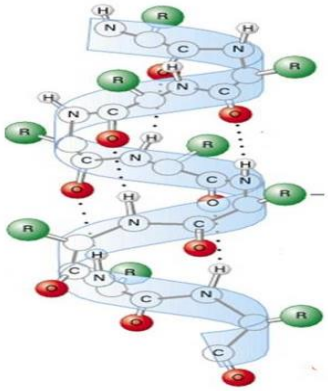
Source: Authors (2018).

To collect the data, a mixed questionnaire was used, in the form of a pre-test, which was later applied as a post-test. Diversifying the instruments of teaching methodologies allows the researcher a more adequate analysis of the evidence (LÜDKE; ANDRÉ, 1986).

In Chart 2, the post and pre-test questionnaire will be presented, consisting of six descriptive questions about the theme “hair”. This instrument was developed based on the ideas of Carvalho, Couto and Bossolan (2012), with adaptations, so that the objectives of this work were achieved.

Chart 2 – Questionnaire applied to students

Issue/Aspect Approached	Question
1. Concepts of amino acids and protein.	What is hair made of?
2. Chemical structure of protein	What (is) (are) organic function(s) present in keratin?

3. Peptide bond	Analyzing the figure below, what structure/arrangement of amino acid interaction does the chain represent? 
1. Smoothing	Considering the types of smoothing capillaries, differentiate chemical from physical straightening.
2. Link: Chemistry and everyday life	What types of chemical straighteners do you know? Name them!
3. Reduction and Oxidation	Could you chemically explain how the process of straightening hair with chemicals takes place?

Source: Authors (2018).

For a better understanding of the hair straightening method, a demonstration experiment was carried out to straighten a thioglycolate-based lock of hair, using a photographic file, which demonstrated the steps of the procedure using a lock of hair.

RESULTS AND DISCUSSIONS

The questionnaire applied before and after the intervention has questions that can be divided into two dimensions:

i. Chemical concepts of proteins - questions 1, 2 and 3;

ii. Relationship between hair straightening and Chemistry - question 4, 5 and 6.

The responses were classified into categories such as: Satisfactory Response (SR), Partial Response (PR), Unsatisfactory Response (UR) and No Response (NR).

In the first dimension, “SR” corresponds to the answers that comprise one or more sources of keratin constitution; two or more organic functions; two or more amino acid interactions. On the other hand, the “PR” category corresponds to the citation of a structural source; one or two organic functions; indication of only one amino acid interaction. And, finally, it is considered “UR” when there is no relationship between protein structure and organic function in the student's response.

For the second dimension, “SR” was considered when there was a relationship between two or more sources of hair straightening and chemical concepts;

chemically explained the smoothing process using concepts of reduction and oxidation. The "PR" category if the student listed a Chemical source and did not explain the process of breaking bonds. And as "IR" was not related to Chemistry, it only mentioned aesthetic procedures. The "NR" category means, for both dimensions, that the question was returned blank, that is, without an answer.

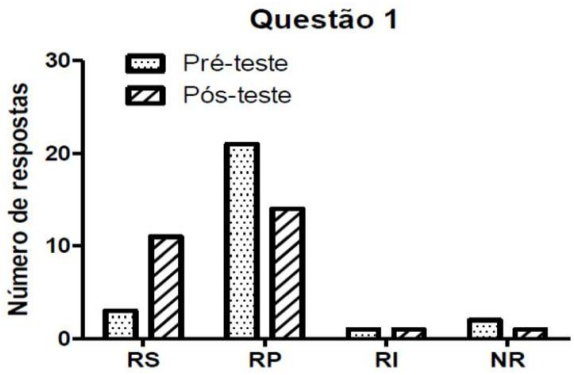
The following figures show the results obtained for each of the dimensions analyzed. For a better understanding of the results obtained, each question was analyzed in a comparative way (pre and post-test). Figures 1-6 show the results obtained in the 1st dimension, chemical knowledge of proteins, in which SR, PR and UR are categorized.

For question 1 "What is hair made of?", the following results were obtained:

In the pre-test, only three students answered the question satisfactorily (SR), whereas in the post-test this question totaled 11 answers with two or more sources of keratin constitution. As examples of SR, we have*: "Keratin is a structural protein with a sequence that, through its interactions, has an α-helix structure.", "It is a protein made up of interactions of amino acids and disulfide and hydrogen bonds".*

In the PR category, 21 students were obtained who, in the pre-test, cited only one source of keratin constitution and in the post-test 14, which demonstrates the evolution to a satisfactory response in the previous category. Both in the pre- and post-test, only one answer was obtained in the UR category. Two students in the pre-test and one in the post-test, abstained on this answer.

Figure 1 – Results of the categories obtained in question 1 for the pre and post test

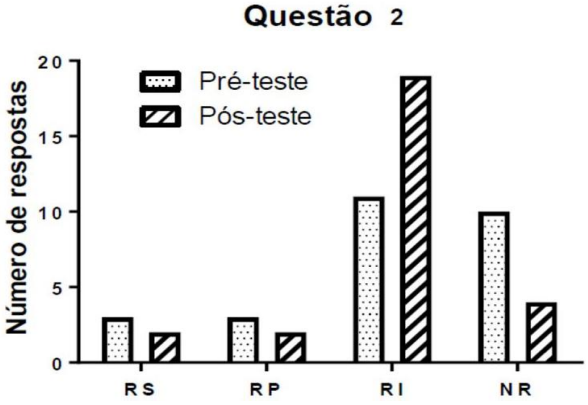


Source: Authors (2018).

It can be seen through the answers that many students associated the constitution of keratin only with amino acids, which justifies the high number of RP in the pre-test. After the lecture, the number of PR in the post-test (14 responses) decreased in relation to the pre-test (21 responses), with a consequent increase in SR in the post-test, obtaining 11 responses. These data indicate that the use of this theme helped to understand the biochemical concepts that involve the constitution of hair, especially the characteristics that involve the composition of a protein. Studies similar to this one (SOUZA *et al*., 2008; KÖLHER, 2011; OLIVEIRA, 2013) obtained positive results when they related chemical knowledge with the subject of straightening.

Question No. 2 presented greater difficulty on the part of the students. To answer it, it was enough to remember the organic functions that constitute the general structure of an amino acid. In the answers, it was observed a high number of students who, when asked about "What is the organic function(s) present in the keratin?", associated the organic function with the structural function, obtaining answers such as: *" [...] the organic function of keratin is structural" and "[...] it is a structure that helps in protection"*. In this same question, other academics related organic function with chemical bond*: "[...] disulfide bridges and hydrogen bonds", "[...] hydrogen bond, ionic bond and disulfide bond".* With this, the results presented in the figures below were obtained:

Figure 2 – Results of the categories obtained in question 2 for the pre and post test



Source: Authors (2018).

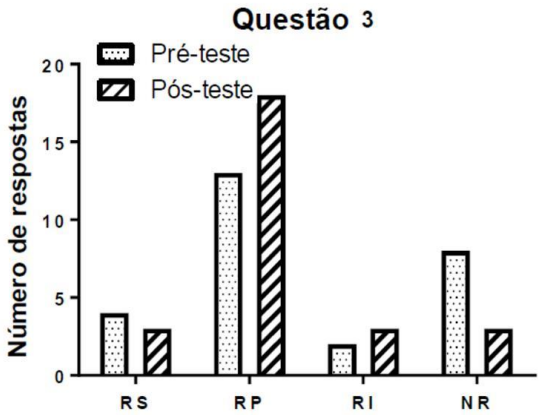
In the pre-test there were three RS and in the post-test the number decreased to two. There were three PRs in the pre-test and two in the post-test. In the same sense, the IR accounted for 11 in the pre-test and 19 in the post-test.

As it was a group of academics attending the 5th semester of graduation, during the intervention, the concept of organic function was not worked, because this supposedly should already be known by the students, since organic functions are part of the 2nd syllabus. semester of the Licentiate Course in Natural Sciences. The general structure of amino acids was detailed showing the functional groups present in it. The number of NR in the pre-test was 10 students and in the post-test it dropped to four.

It is believed that the erroneous correlation obtained in this question is due to the fact that the academics may not have been able to interpret the question, or that they only focused on the word “function”.

Question 3 asked about amino acid interactions in the α-helix chain.

Figure 3 – Results of the categories obtained in question 3 for the pre and post test

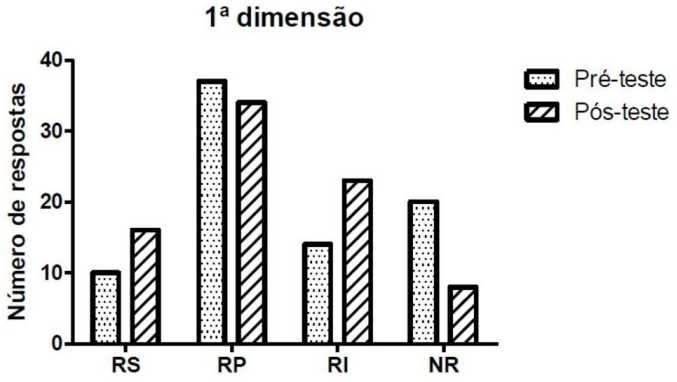


Source: Authors (2018).

For this question, the RS category totaled four responses in the pre-test and only three in the post-test. With the PR category in the pre-test, 13 responses were obtained and in the post-test the number increased to 18 responses. One of the students who had responded satisfactorily in the pre-test, passed the RP in the post-test, and another, who previously answered unsatisfactorily in the pre-test, also became PR. Two UR were obtained in the pre-test and three in the post-test, it is believed that the difficulty lies in differentiating the structures that make up an amino acid from the interactions between amino acids, an example of answers: “carbohydrates with R bonds”; “disulfide bonds”; “secondary structure”. The confusion of concepts already demonstrated earlier in question 2 remains in evidence in question 3 as well. Even if the questions address different aspects, the answers obtained are practically the same, which highlights the difficulty in differentiating links between interactions and functional groups. In the NR category in the pre-test there were eight responses and in the post-test three.

It was observed that students had difficulties in the questions of the 1st dimension, which correspond to questions 1 to 3, perhaps because they require knowledge of chemical concepts. Chart four encompasses the responses from this dimension.

Figure 4 – Results of the categories obtained in the 1st dimension



Source: Authors (2018).

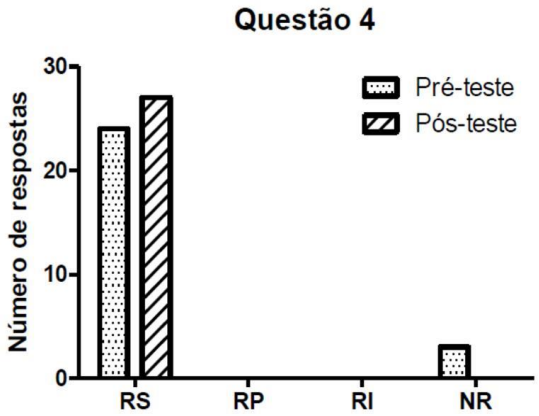
When asked about the chemical knowledge of proteins, the number of PR and UR was higher than the SR, which highlights the difficulty in formulating complete answers based on the knowledge acquired during graduation. All PR brought correct and corresponding knowledge to the question, however incomplete.

It was observed that many mentioned that keratin consists only of amino acids and the only interaction is the α-helix. Another factor is the UR, which, according to the criteria established in table six, are answers that do not correspond to the question. The research carried out by Carvalho, Couto and Bossolan (2012), with high school students, points to a similar result, in which those surveyed demonstrate difficulties in generically defining the function of proteins and their constitution.

The results for the 2nd dimension will be presented below, questions 4, 5 and 6:

In this question four “Considering the types of hair straightening, differentiate chemical from physical:” the results obtained were positive.

Figure 5 – Results of the categories obtained in question 4 for the pre and post test



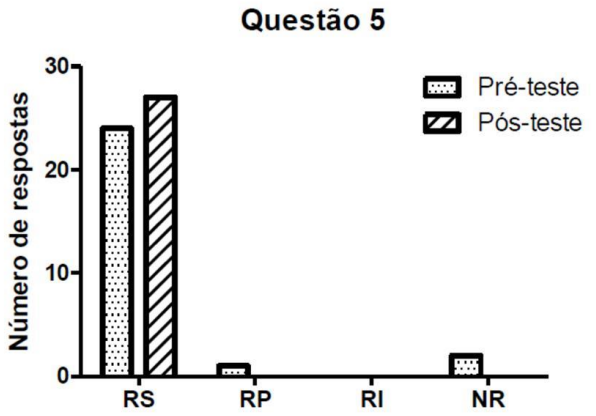
Source: Authors (2018).

In the pre-test 24 students were obtained in the SR category and in the post-test 27, that is, the total number of students knew how to differentiate chemical from physical straightening. Some examples of answers obtained: *“Chemical: runs inside the hair. Physical: occurs on the outside of the wire”; “[...] the chemical straightening acts by breaking the disulfide bonds and the physical one only removes hydrogen”; “Chemical straightening happens from the inside out, whereas the physicist, ex: flat iron, only breaks the weakest bonds, which are those of hydrogen”*.

The pre-test had pointed out three students who had not answered the question and later were included in the SR category. The positive result of this question is due to the fact that the respondents understand the concepts of physical and chemical transformations and that 99% are female, which is supposed to be a group more used to hair cosmetic procedures. Confirming the research carried out in 2013 which points out the great growth of aesthetic procedures due to the interest of the general population for these services (IBOPE, 2013).

In question number five: "What types of chemical straightening do you know?" the results listed in figure 6 were obtained.

Figure 6 – Results of the categories obtained in question 5 for the pre and post test

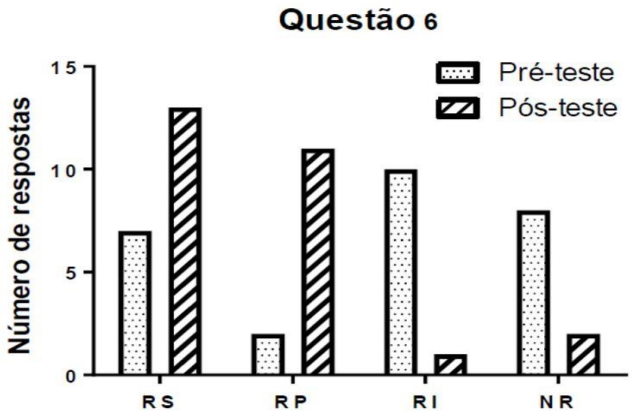


Source: Authors (2018).

For this question, 24 SR, one PR and two NR were obtained in the pre-test. In the post-test, the totality responded satisfactorily. Although the question was about straightening, some mentioned the "permanent" procedure, but the chemical process is the same so the answer was not disqualified. Because, according to Abraham (2009), changing the structural shape of hair requires breaking connections so that the hair takes on the desired shape.

In the analysis of question 6, "Could you chemically explain how the process of straightening hair with chemicals occurs?", the following results were obtained:

Figure 7 – Results of the categories obtained in question 6 for the pre and post test



Source: Authors (2018).

In the pre-test, seven students responded satisfactorily (SR) and in the post-test 13 were surveyed. Examples of SR are*: "To make the straightening there is a reducer that breaks the hair by adding H, after defining the shape of the hair, the oxidizer is applied to give it shape"; "Break the disulfide (reducing) bonds hydrogen rebuilds with disulfide (oxidant) bonds to give the desired shape."*

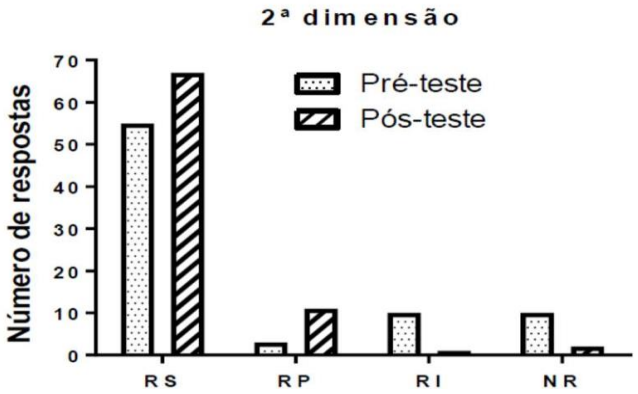
The PR category totaled two responses in the pre-test, and in the post-test 11 students who explained without using all the chemical concepts necessary to explain the hair straightening procedure. Examples*: "[...] Place the product that will open the cuticle and break the disulfide bridges"; "[...] in the smoothing, the disulfide bridges are broken and reorganized in a linear way"; "[...] chemical*

straightening breaks the disulphide bridges in the hair". In this category, all mentioned the disulfide bridges, which indicates that they understood the main point of the process.

In the UR category, the pre-test had 10 answers, the post only one. In this category, students who did not use chemical concepts to explain the smoothing process were classified, citing only chemical products in the process; *"[...] it is necessary to apply a formalin or thioglycolate-based product so that you can obtain the desired shape (plain)"; "[...] it opens the hair cuticle with ammonia and the formaldehyde mummifies the hair, removing all the water in the molecule"; "the product acts on the hair cortex modifying the hair structure, as molded"*. 8 students in the pre-test and 2 in the post-test did not respond (NR).

Based on the results of the 2nd dimension (Figure 8), an increase of 12 SR was obtained in the post-test, totaling 67 responses.

Figure 8 – Results of the categories obtained in the 2nd dimension for the pre and post test



Source: Authors (2018).

This is a satisfactory result, since the other categories PR, UR and NR, both in the pre- and post-test, comprised less than 18% of the total responses. This suggests that the students were able to transcribe this knowledge of the chemical process of hair straightening and correctly answer the question. Possibly, this result expresses how the knowledge of day-to-day facts helped in the scientific understanding of the studied group regarding the aesthetic smoothing procedure, as stated (SILVA; MARCONDES, 2010; WARTHA *et al*., 2005), corroborating with one of the aspects that characterize the thematic workshop.

FINAL CONSIDERATIONS

Based on the results presented above, it can be concluded that the students, subjects of this research, had difficulties in deepening biochemical concepts, but an easiness to associate these concepts with everyday life.

The lowest effectiveness obtained was in the results that encompass the questions of the 1st dimension, more theoretical and in-depth knowledge of chemistry and biochemistry. These results showed conceptual problems and lack of clarity in the answers obtained, making them a possibility to reflect and research

ways and/or solutions to improve the understanding of this scientific knowledge by the students.

In the data related to the 2nd dimension, which comprises the relationship of chemical knowledge and association with the types of straightening, there was an improvement, perhaps because it is a closer approximation of the reality of the subject to biochemical concepts.

On the other hand, when submitted to the resolution of issues related to daily life, the performance obtained by the students was better, which confirms the effectiveness of thematic activities that combine daily issues with scientific concepts, as shown by studies already mentioned in this work.

Finally, as research emerges that address themes related to different themes and present in the daily lives of those surveyed, new opportunities for the study of scientific concepts familiar to the lives of students are added.

This contributed to the understanding and clarity of school contents, since what is learned at school is an extension of the environment in which we live. It is expected that this work contributes to the teaching of Chemistry and other areas of knowledge, favoring the relationship between student and content.

A TEMÁTICA "ALISAMENTO CAPILAR" COMO PROPOSTA DIDÁTICA PARA O ENSINO DE CONCEITOS BIOQUÍMICOS

RESUMO

Considerando a importância de conhecimentos sobre ciência e como eles auxiliam para uma participação ativa e responsável na sociedade atual, o presente estudo objetivou verificar o conhecimento prévio e posterior à proposta didática sobre o tema cabelo, avaliando a compreensão de conceitos relacionados às proteínas, aminoácidos e reações de oxirredução. Participaram desta pesquisa 27 acadêmicos do 5º semestre do curso de Licenciatura em Ciências da Natureza, a proposta didática foi aplicada com o uso de aula expositiva e experimento demonstrativo, e avaliada por meio de questionário prévio e posterior à proposta. No resultado deste estudo, detectou-se que os acadêmicos apresentaram dificuldades com os conceitos específicos de proteínas, o que foi demonstrado pela pouca clareza no desenvolvimento das respostas. Porém, quando questionados através de conceitos químicos relacionados ao cotidiano obteve-se resultados satisfatórios. Por fim, parte deste trabalho corrobora com a eficácia de atividades temáticas aliadas às questões do cotidiano, confirmando dados já presentes na literatura. Porém, mais estudos são necessários para suprir a demanda no entendimento de conceitos científicos de bioquímica, já que, neste contexto, a presente proposta não demonstrou eficácia em sua totalidade.

PALAVRAS-CHAVE: Proteínas. Aminoácidos. Ensino de Ciências.

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