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Elaboration of a problem-situation applied to the decontamination of mercury waters present in the lands of the Yanomami indigenous peoples

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ABSTRACT
For a long time, several methodologies have been studied in order to facilitate the process of teaching and learning chemistry, which is a discipline considered complex, because the forms of teaching do not always lead the student to clearly understand this science. Considering problem solving as a proposal that contributes to the student having autonomy in classes, actively participating in the teaching process and being challenged to build new knowledge, this research addressed the use of investigative questions in experimental activities based on problem-situations. In this qualitative research, students of the discipline of physical chemistry, of the chemistry degree course, were asked to elaborate and evaluate experimental investigative activities by means of problem-situations (PS), in which the resolution of the problem was obtained experimentally, with the objective of PS replacing the traditional script of experimental class. In this work, students were asked to develop a PS with the objective of electrochemical decontamination of mercury-contaminated water on the lands of the Yanomami indigenous peoples. Since the problem-situations elaborated by the students did not meet all the proposed characteristics, the undergraduate students of this research proposed a problem-situation in which the students would have to perform an electrochemical experiment to decontaminate the water, and then some chemical analyses to confirm that the water does not contain mercury. It was found that chemistry undergraduates had difficulties in the elaboration of these problems, despite having already studied this theme in another discipline. This shows the need to intensify the study of this theme in the training of chemistry teachers.

Keywords: Electrochemistry, Problem situation, Mercury.

1 INTRODUCTION

For a long time, several methodologies have been studied to facilitate the teaching and learning process. Although the evolution of studies is evident, we can still perceive several challenges to be overcome in the field of education. One of the ways to cooperate for development in the teaching and

learning process is to use contributions from important philosophers who have made it possible, through their studies, to develop innovative teaching methodologies and a greater understanding of the learning process.

In traditional teaching, the methods correspond to a transfer of knowledge from the educator to the student, in this way, the individual learns through the exposure of information, where the teacher holds all the knowledge. Freire (1988) addresses the importance of educators creating ways to contribute to the construction of the student's knowledge, without this process being limited to just a transfer of knowledge. In view of this scenario, we have Chemistry as a discipline sometimes considered complex, because the forms of teaching do not always lead the student to clearly understand the study of the subject and its transformations.

Ferreira and Justi (2008) comment on learning chemistry, relating some difficulties encountered by students in understanding this subject to non-concrete aspects found during their approach. Despite these conflicts, chemistry as a discipline makes teaching by experimentation possible. This type of method, because it is illustrative and practical, attracts the attention of students, bringing the opportunity to build a class in which the approaches are carried out, not only in an expository way, or with the following of pre-established scripts, but also bring a practical notion of this subject. These characteristics can be used in order to establish proposals that stimulate students' reasoning, such as the elaboration and resolution of problem-situations. The articulation of ideas in the solution of problems can be carried out within the laboratory, through experimentation, allowing for a diversification in teaching methodologies.

The use of experimental activities in Chemistry classes aims to facilitate the teaching and learning process, in which students can actively participate because this science is experimental. However, it is not possible to innovate teaching if its evaluation is linked to the traditional, quantitative and classificatory molds (ANDRADE; VIANA, 2017). In addition, the new perspectives for High School say that Chemistry should be valued, as a cultural and essential instrument in human education, as a co-participant in the interpretation of the world and responsible action in reality (BRASIL, 2006). And for this to happen, according to Freire (1996), the teaching practice must reinforce the critical capacity of the student, his curiosity and his insubordination.

One of the philosophers who contributed to the development of innovative teaching methodologies was Piaget, his research carried out through interviews brings a constructivist perspective of knowledge. Carvalho (2013) comments on the importance of proposing a problem according to Piagetian research, and evaluating the interviews conducted by him in these researches, he understands that the proposal of a problem that students can solve in the classroom is an important factor, being a watershed between expository teaching and teaching in which it stimulates the student's autonomy for the construction of knowledge. Therefore, it is possible to affirm that the elaboration and

resolution of problem-situations requires the participation of the student, giving him a position of autonomy in the classes and, consequently, the opportunity to stimulate critical thinking.

According to Meirieu (1998), the problem-situation is something in which its resolution cannot be possible if the subject does not first have a precise knowledge about the subject and this knowledge constitutes the objective of the situation, which is realized when the subject overcomes the obstacle to fulfill the task. In this way, the student builds his learning by overcoming the obstacle. Stuart (2014) makes a relationship stating that the investigative experimental activities have their origin in a problem-situation, and it is important that this situation is of interest to the student and that, in its description, the obstacle of the problem, is not difficult to the point of discouraging the student to complete the task. Maldaner (2020) states that experimental activities facilitate the process of acquiring knowledge that aims to bring concrete objects closer to their theories, and in this process, the origin of more knowledge about these objects occurs.

Considering problem solving as a proposal that contributes to the student having autonomy in classes, actively participating in the teaching process and being challenged to build new knowledge, this research addresses the use of investigative questions in experimental activities. The participating students had a conceptual theoretical approach related to the elaboration of problem-situations and also on methods of experimentation, worked in the physical chemistry classes. The theoretical classes aimed to prepare the student in the construction of a critical consciousness, which is a fundamental condition for the elaboration of a problem-situation.

According to the above, we propose the following research question: Can experiments by investigation contribute to the undergraduate student in chemistry, in the development of critical thinking and creativity to solve critical problems?

To answer this question, we consider the following assumption: The investigative approach implies, among other aspects, planning investigations, using experimental setups to collect data followed by the respective interpretation and analysis, in addition to communicating the results. Such an approach allows students to free themselves from the passivity of being mere executors of instructions, as it seeks to relate, decide, plan, propose, discuss, report and other implications contrary to what occurs in the traditional approach (HOFSTEIN; LUNETA, 2004).

In this research, the physical chemistry students of the chemistry degree course were asked to elaborate and evaluate the experimental investigative activities through problem-situations (PS), where the problem resolution must be obtained experimentally, with the objective of PS replacing the traditional experimental class script. The requested problem situation had the theme of electrochemical decontamination of mercury-contaminated waters on the lands of the Yanomami indigenous peoples.

To solve the problem, the students received only explanations related to the conceptual and procedural content corresponding to the experiment. For the analysis of the results, criteria were elaborated based on Carvalho (2013) and Meirieu (1998).

2 RESULTS AND DISCUSSION

After the analysis of the problem-situations elaborated by the students, it was found that none of them met all the characteristics proposed, therefore, the scientific initiation students of this research proposed the problem-situation shown in chart 1.

Table 1. problem-situation.

Mercury is a metal widely used by illegal miners in order to promote the obtaining of gold in a "pure" form and after its use, this mercury is thrown into the rivers causing water pollution with health impacts. The constancy of this practice has brought several harms to the Yanomami indigenous peoples, in this region several rivers have a high rate of contamination, bringing a situation of great risk to this population. Faced with all the calamity suffered by the Yanomami peoples, a group of students from the chemistry degree course were sensitized and decided to study a way to decontaminate these waters, thus opting for the electrochemical route. Considering this, how can you help students in this process of conducting an electrochemical experiment that decontaminates this water, to ensure that it is completely free of mercury? And knowing that to carry out this study they have an analytical center and a physical chemistry laboratory with a voltage source, metal sheets of various metals and various salts.

Source: Prepared by the author, 2023.

We consider that the proposed SP meets the objective of solving the problem in an experimental way and the criteria of SP of Carvalho (2013) and Meirieu (1998). To solve it, the students would have to perform an electrochemical experiment to decontaminate the water, and then some chemical analysis at the analytical center to confirm that the water does not contain mercury.

3 FINAL THOUGHTS

It was found that chemistry undergraduates had difficulties in the elaboration of these problems, despite having already studied this theme in another discipline. This shows the need to intensify the study of this theme in the training of chemistry teachers.

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