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Didactic sequence on mutations: proposal for the study of degenetics in the High School

ARTIGO

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Abstract
Genetics is one of the central themes of Biology and the understanding of its concepts is essential for the critical analysis of situations. Within this great area of knowledge, understanding what mutations are is of significant importance when addressing this content in high school. Understanding how mutations occur, as well as their implications, is fundamental to understanding evolutionary processes. In this sense, the present study aimed to work on the content of mutations through didactic sequences with the active participation of first grade high school students. The didactic sequence was developed in five fifty-minute classes with the participation of 38 students. It was observed that the strategies used facilitated the understanding of the concepts of the theme addressed, as well as stimulated the participation and engagement of students in the proposed activities.
Keywords: Mutation. Genetics. FollowingTeaching.

Sequência didática sobre mutações: proposta para o estudo degenética no Ensino Médio

Resumo
A genética é um dos temas centrais da Biologia e a compreensão dos seus conceitos são essenciais para a análise crítica de situações. Dentro dessa grande área de conhecimento, o entendimento sobre o que são mutações, é designificativa importância, quando, se aborda esse conteúdo no Ensino Médio. Compreender como as mutações ocorrem, bem como as implicações destas é fundamental para a compreensão dos processos evolutivos. Neste sentido, o presente estudo objetivou trabalhar o conteúdo de mutações através de sequências didáticas com a participação ativa dos alunos da primeira série do Ensino Médio. A sequência didática foi desenvolvida em cinco aulas de cinquenta minutos com a participação de 38 alunos. Observou-se que as

estratégias utilizadas facilitaram à compreensão dos conceitos do tema abordado, bem como estimulou a participação e o engajamento dos alunos nas atividades propostas.
Palavras-chave: Mutação. Genética. Sequência Didática.

1 Introduction

Genetics is one of the fundamental themes of Biology teaching and knowledge of the essential concepts of this area is important for understanding many practical and everyday situations.

According to Vidrik, Almeida, Malheiro (2020), the teaching and learning process in the field of genetics, specifically the content of genetic mutations, is hampered by blockages that hinder the teaching of this area of knowledge. One of the most effective ways to minimize teaching deficiencies is the use of differentiated techniques, especially those that are worked on during didactic sequences from an investigative perspective.

It is important to address the subject of mutation in Biology in high school involving problematizing questions, because it allows the student to understand what are the relevant aspects related to mutation within the evolution and variability of species. LÓPEZ; PIERA; KALINER (2004) say that understanding the concept of mutation is paramount as knowledge for any citizen, because it enables the understanding of the differences between people, fundamental for the acceptance and social inclusion of these people.

The National Common Curriculum Base (BNCC), with regard to Biology, advocates an important skill to be developed by the student, namely:

> Analyze and debate controversial situations about the application of knowledge in the area of Natural Sciences (such as DNA technologies, stem cell treatments, weapons production, forms of pest control, among others), based on consistent, ethical and responsible arguments, distinguishing different points of view (BRASIL, 2018p.545).

In this sense, a Biology teaching that describes the reality in which the student is inserted, will facilitate the study and learning of difficult contents to be understood.

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Mutation because it is an abstract subject, needs to be worked bringing issues that are close to the students, always trying to bring a correlation between content and everyday life, for this you can use resources such as science fiction films.

According to Oliveira (2008), although most claim that genetic mutations are harmful events, these associated with the process of natural selection are necessary phenomena for the evolutionary process. It is observed that in the teaching of this content, some obstacles are faced, among them stand out: pedagogical practices guided only by the textbook, with expository classes without deepening, decontextualized and without any relationship with the reality of the students.

On the importance of the theme, it is interesting to note that random changes can occur in our genetic material, and these are extremely necessary. DNA contains bases for the production of structural and metabolic components, and changes resulting from mutations can alter the way proteins are transcribed and expressed in living organisms. These changes can generate genetic variability and the emergence of new species. Mutations occur at random and their emergence may be linked to evolutionary advantages for species.

Considering that the study of mutations is pertinent and that it should be worked on in high school in a meaningful way for the student, the present study aimed to develop a didactic sequence on mutations using active methodologies such as the inverted classroom, peer learning, problem-based learning (PBL) with first grade high school students.

The didactic sequence was based on the guidelines that conceive Biology as a science that considers the student's protagonism and critical analysis of everyday life as essential for the construction of knowledge.

2 Methodology

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The didactic sequence was developed at the State School Professor José Nogueira which is located at Rua 6 de Janeiro, SN, Bairro Santo Antônio, Mossoró / RN. The students participating in the study were regularly enrolled in the 1st grade of high school that works articulated to the technical course in nutrition and dietetics. The class had a total of 38 students and used a total of 5 hours / class for its application. The proposed methodology was adapted to the conditions of the physical resources of the school environment, as well as to the previous knowledge of the students, since the target audience of the application had not yet studied on the subject of mutation. The proposal consisted of encouraging research, sharpening the curiosity and protagonism of the students involved in the study.

The steps developed during the didactic sequence were as follows: 1) Guidelines on conducting the class and introducing the subject. This phase was schematized considering the following pedagogical strategies: a) Guiding questions to introduce the content; b) Directing research; c) Suggested film: X-Men first class; d) Debate and socialization; e) Group dynamics: How do mutations occur? f) Unraveling the puzzle: What is the syndrome?; g) Discussion and reflection on the dynamics and problem question; h) Group study of the main points involving the theme mutation; i) Construction of conceptual map; j) Exhibition of final discussion of ideas; 2) Development of activities. The sequence was developed in a total of 05 (five) classes of fifty (50) minutes each.

In the course of the application the following conducts were developed: a) Introduction to the theme with probing of the previous knowledge of the students about the subject that guided the main theme that was introduced. Secondary subjects such as genetic code, syndromes, meiosis, among other related subjects were also addressed. This was necessary to create a network of connection between the subjects addressed within the knowledge area; b) Practice and reflection. At the end of each activity proposal conversation circles and the critical analysis of the acquired knowledge were carried out; c) Socialization of knowledge in a collaborative way with the other target pairs of the study; d) Relationship between the concepts of genetics that were being worked on with

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those presented in the science fiction film "X-Men first class"; e) Dynamics with the triggering question: How do mutations occur? This step took place individually. Students would have to reproduce drawings created by their peers as faithfully as possible. At the end they would have to analyze and relate the results to the contents studied.

In the next step, the student was challenged to unravel a puzzle (problem question) and at the conclusion of the task they would have to say which syndrome the puzzle was about and point out which clues led them to that conclusion. 3) Systematization, evaluation and finalization. Finally, the students produced a conceptual map in order to systematize all the content and concepts duly appropriated by them in the development of the didactic sequence in question.

3 Results and Discussion

The different strategies adopted during the application of the didactic sequence generally promoted student engagement in what was proposed. However, as several methodologies were used in this process, an individual analysis and discussion of each stage of this sequence is necessary. Therefore, in order to better understand the steps that led to these discussions, it is necessary, at times, to mention how methodologically it was proceeded.

This sequence was applied in a 1st grade high school class. It is important to emphasize that in the period proposed for the actions of the didactic sequence the class had not yet studied the subject in more depth. Based on this assumption, the student's research and autonomy were essential points in the development and success of this methodology. During the sequence we sought promote the participation, curiosity and especially the protagonism of the student in the formation of their knowledge.

It is important to emphasize that the students in the class in question did not have prior scientific knowledge of the subjects. The knowledge was superficial and based on lived experiences. This was detected during the survey of their prior knowledge in a

conversation circle at the beginning of the proposal. Some guiding questions were launched and their resolution was encouraged.

These questions were answered individually and at home through research. As a way to sharpen curiosity and provide a reflection on the theme of mutation, it was suggested to the student that they critically watch a science fiction movie that has in its plot, issues related to the theme addressed.

At the next meeting, the students brought the answers to the guiding questions and a debate followed on the subject. The relationship of the content understood through the research with the plot of the proposed film happened spontaneously. This was detected through direct observation of the appropriation of key concepts on the proposed theme by the students involved in the application. It was noticed that there was involvement and a consequent relationship between the concepts involved in the theme.

Analyzing the film as a didactic tool, it was observed that it was very effective in the development of the theme, considering that from what they understood from the film and in the research carried out it was possible to identify during the discussions that they were able to relate which points of the film were truly related to existing scientific knowledge.

For Duarte (2009) the film as a didactic resource becomes a valuable instrument for the debate on issues related to Science, since the films bring plots that enable the teacher to work concepts and theories that sometimes present themselves, especially in science fiction films, in a distorted way and can generate in people a misconception about the facts of Science (DUARTE, 2009).

The next strategy used in the proposed didactic sequence was a group dynamic. The rules were exposed and the students organized themselves in rows. It is worth mentioning that the production of a student's drawings depended crucially on the production of the other who was positioned just ahead, making evident the need for concentration for the effective success of the proposed. Students should replicate drawings according to those produced by those in front of them. The orientation was that

they should reproduce the drawing as reliably as possible. The dynamic ends when the last in line is reached.

The drawings produced were compared with each other and the relationship with the content established. The students noticed many changes between the initial drawings and those produced by the students who were positioned last in the pre-established order, as well as the differences that occurred during the passage from student to student. In order to systematize the ideas, questions were asked such as: What does this dynamic have to do with the mutation process? This dynamic is relatively simple, however the students' engagement was satisfactory both in the sense of participation and in the sense of interrelations with the content. During the execution, we observed that they frequently explored the term mutation, thus being considered positive, efficiently meeting the objectives initially proposed.

Among the methodologies applied, Problem-Based Learning (PBL) was an important stage of the study presented here. This methodology has as its basic principle the use of everyday problems in order to stimulate the conceptual, procedural and attitudinal development of the student (BOROCHOVICIUS; TORTELLA, 2014).

According to Souza and Dourado (2015) problem-based learning (PBL) has advantages such as motivation, integration of knowledge and development of critical thinking skills and the interaction of interpersonal skills. To work with PBL, we divided the class into groups and distributed a problem question to each of the teams. According to Pozo (2002), between working individually or performing tasks with mutual cooperation, the results are better when interaction between students is favored. In this sense, the teams received the problem question and based on the data provided in the question statement, as well as the data provided in the question statement as the knowledge acquired in the previous steps, they should discuss and analyze the data and find the resolution to the reported problem.

The resolution of the problem question also had a good engagement on the part of the student, however it was verified difficulty on the part of the students in relating the

concepts with the proposed context. In the end, they were able to identify which syndrome was portrayed in the puzzle, and what relationship existed with cell divisions. In general, this activity was a bit challenging because, as previously mentioned, they had not previously studied the concepts of mitosis and meiosis among others related to the theme. However, it was possible to approach the subject minimally, which for the stage that was being developed during the didactic sequence, was considered satisfactory

To close the didactic sequence, it was suggested to schematize the content in a conceptual map developed in groups. Based on the theory of meaningful learning of David Ausubel (1989). Concept maps are considered important tools for organizing and representing knowledge, as they show - through propositions, or elucidative enunciations - the connections established between key ideas (NOVAK, 2008).

They were provided with material on mutation to research and asked to make additional inquiries in other sources for the construction of the concept map. Students should perform this step at home and the results should be exposed at the next meeting. Again we observed the adherence, where all groups delivered the proposed, however, it was observed that the maps, in many cases, were only copied from the internet, not really reflecting the student's knowledge, this is a problematic situation and reflects in the teaching work, because what should be a task performed by the student in a more autonomous way, with own construction, ends up being a copy of something already ready, which can compromise their real learning (CACHAPUZ, et al.; 2005).

Although the maps brought by the students do not reflect their own elaboration, it was possible to identify in the conversation circle and in the analysis of the material produced, that most groups were able to easily explain the concepts addressed in the maps. Thus, we found that the tool was also important for the development of the theme.

The final evaluation of the didactic sequence developed with the students is that the different strategies gave dynamism to the teaching of the theme genetic mutation, a subject that is abstract and difficult to understand for the student. Campos and Nigro (1999) reinforce that the teacher when using different tools in the classroom to work the

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school contents contributes to mobilize different skills of the students, in this sense, their learning becomes more significant and lasting.

It is also added as a point identified in this study, that if the students who participated in the activities had already studied the theme of mutation, the questions asked during the discussions would have been more productive. In general, the didactic sequence was evaluated as a strategy that enhanced student learning on the theme of mutation.

4 Final considerations

The investigation carried out made it possible to understand the guiding subject of this sequence, as well as the appropriation of knowledge and practices related to the study of genetic mutations.

The verification of the existence of some difficulties in mastering the mutation theme, detected from the analysis of the results of the activities, shows the importance of teaching from the survey of students' prior knowledge, which gives meaning to school knowledge. Thus the use of contextualized problem situations can assist in the construction and reworking of concepts, procedures and attitudes, by motivating the learner to appropriate knowledge. Aspects that count a lot in the success of the teaching methodologies developed in the classroom, are very related to the motivation and interest of the student.

Thus, the didactic sequence proposed and developed within the scope of this study, gave the student the opportunity to learn about mutation, being possible to demystify some distorted ideas about this subject. However, it is necessary to deepen the theme to answer questions and deepen the content, considering that for the students who participated in the study the subject had not yet been worked on, in this sense, it is understood that new teaching methodologies are elaborated and developed as a way of

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working on genetic mutation in a perspective that the student learns significantly about the theme.

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