Didactic sequence with application of low-cost practice with the use of biotechnological resources

Sequência didática com aplicação de prática de baixo custo com uso de recursos biotecnológicos

Secuencia didáctica con aplicación de prácticas de bajo costo con el uso de recursos biotecnológicos

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RESUMO

Objetivo aplicar metodologias práticas de biologia no ensino médio em escola estadual de Feira de Santana do período noturno, utilizando a biotecnologia com intuito de proporcionar novas experiências didáticas para jovens e adultos. **Método:** A abordagem metodológica é de modo qualitativo e descritivo através de relato de experiência, com aplicação de aula prática com materiais de baixo custo sobre a extração de DNA.**Resultados**: Com relação às dificuldades enfrentadas na Educação Básica, esta forma de metodologia do trabalho realizado mostrou-se produtiva, uma vez que possibilitou um espaço para discussão e troca de experiências dos alunos associando com seu cotidiano. **Conclusão**: Esta pesquisa mostrou que o uso desta abordagem didática facilitou o entendimento dos conteúdos trabalhados e do diálogo aluno-professor, evidenciando-a como uma ótima ferramenta para ser trabalhada na sala de aula.

Descritores: Prática de Ensino; Ensino Médio; Biotecnologia; Extração de DNA; EJA

ABSTRACT

Objective: to apply practical biology methodologies in high school at a state school in Feira de Santana at night, using biotechnology with the aim of providing new teaching experiences for young people and adults. **Methods:** The methodological approach is qualitative and descriptive through experience reports, with the application of practical classes with low-cost materials on DNA extraction. **Results:** In relation to the difficulties faced in Basic Education, this form of work methodology proved to be productive, as it provided a space for discussion and exchange of students' experiences associated with their daily lives. **Conclusion:** This research showed that the use of this didactic approach facilitated the understanding of the content covered and the student-teacher dialogue, highlighting it as a great tool to be used in the classroom.

Descriptors: Teaching Practice; High school; Biotechnology; DNA extraction; EJA

RESUMEN

Objetivo: aplicar metodologías prácticas de biología en la escuela secundaria en una escuela pública de Feira de Santana en horario nocturno, utilizando la biotecnología con el objetivo de brindar nuevas experiencias de enseñanza a jóvenes y adultos. **Métodos:** El enfoque metodológico es cualitativo y descriptivo a través de relatos de experiencia, con la aplicación de clases prácticas con materiales de bajo costo sobre extracción de ADN**. Resultados:** En relación a las dificultades enfrentadas en la Educación Básica, esta forma de metodología de trabajo resultó productiva, ya que brindó un espacio de discusión e intercambio de experiencias de los estudiantes asociadas a su vida cotidiana. **Conclusión:** Esta investigación demostró que el uso de este enfoque didáctico facilitó la comprensión de los contenidos tratados y el diálogo alumno-profesor, destacándolo como una gran herramienta para ser utilizado en el aula.

Descriptores: Práctica Docente; Escuela secundaria; Biotecnología; Extracción de ADN; EJA

EXPERIENCE REPORT

Introduction

The teaching of Biological Sciences is generally seen as a teaching of rote learning in the view of the students, thus hindering learning, because the act of memorizing is restricted to the moment and later the information can be forgotten. When the student learns the content taught by the teacher, he takes this knowledge with him to his life and not only in the moment, thus being able to apply it in various ways or in different situations throughout his life.

Teaching science is not restricted only to executing the standard model when exposing the contents of books, but rather educating citizens by showing that science is in their daily lives and not only in books, associating the contents with practice, thus making them critical citizens who reflect on their practices, who question and raise hypotheses, becoming capable of making decisions that involve scientific themes. Given this, the classroom should be a space not only for the transmission of content, but a place for critical reflection around science and its various contributions to citizenship. For this reason, the teacher has an important role in the formation of citizens, leaving aside the traditionalist model and becoming a critical-reflective teacher, reviewing their teaching practices and applying them to the context in which they are being inserted.

Science has been gaining a greater space in society due to its various contributions and applications, and genetics, which is an area of science, has also been growing.[1]

Biotechnology has been present in society since ancient times, even without knowing its knowledge through fermentation using microorganisms. It is an interdisciplinary science, thus managing to associate other sciences to their contexts, thus expanding their functionalities and contributions. It consists of the aggregation of knowledge technologies with biological agents that may vary according to their application. From these discoveries, goods and services for society are produced.

Biotechnology in practice consists of a multidisciplinary science, where it encompasses other areas of knowledge, which we can mention: classical genetics, biochemistry, immunology, microbiology, molecular biology, chemistry, law and philosophy, this aggregation of knowledge together with biological agents, being the products result in products of Biotechnology, which can be used in broad scientific fields, Among them we can mention agronomic, medical, industrial, energy, chemical and environmental.[2]

With its various applications in students' daily lives, one of the tools that can be used in education to bring students' interest in science is to show its performance in the present, to show how it acts in our daily lives, so that they can assimilate theory with practice. Contemporary society is strongly influenced by scientific and technological knowledge, so it is necessary to reflect on the amplitudes of this area of knowledge and its implications in Brazilian Basic Education.

The use of practical classes should be a tool to be adopted in order to promote interaction between teacher and student, since this didactic tool is a facilitator and optimizer of teaching-learning, being able to assimilate and complement theoretical and practical concepts. For this reason, it is seen as indispensable in the teaching of science and biology, thus obtaining benefits for both the teacher and the student, especially in a post-pandemic moment.

On the other hand, the vast majority of public schools do not have laboratories, which makes it difficult for the teacher to plan and execute practical classes, due to this investing in low-cost practices is a viable solution for practical classes, since it becomes accessible to teachers and to the educational institution.

The motivation of this research was based on the experience without a classroom since the participation in the PIBID program at IFBA in Feira de Santana where I was able to follow face-to-face classes in a structured school, with didactic resources, practical laboratory classes, laboratory equipped with various didactic materials, being able to see in practice the greater interest of students for practical classes and less interest for traditional classes.

It is notorious that the teaching of biology brings with it the use of many concepts that are difficult to understand, influencing the lack of connection of these terms with the reality that is experienced by these students, becoming one of the frequent problems faced in the classroom. With the advances of biotechnology in contemporary times, it is necessary to insert these new themes in the classroom.

Therefore, the problematization of this research seeks to know: Would the use of low-cost practical methodologies with the use of biotechnological resources applied to the teaching of biological sciences facilitate the learning and interaction process of students in a state public school in the municipality of Feira de Santana?

As for the general objective of this research, it aims to investigate the effectiveness of the application of low-cost practical methodologies in biology with biotechnological resources in High School in a State School of Feira de Santana at night, in order to understand and analyze the interactions of the subject in his learning process of EJA teaching. Based on this, the specific objectives seek to investigate the students' previous knowledge about biotechnology and its applications in everyday life, identify and recognize the DNA molecules extracted from plant cells, understanding their importance for life, stimulating the search for concepts and; analyze the importance of practical classes for the significant construction of knowledge according to the student's view through a dialogue during the practical class.

Method

This study has a qualitative approach, as qualitative research is characterized by evidencing interpretation; focus on the process rather than the outcome; emphasize the context and recognize impacts that may influence the research and the researcher.[3] Applying the methodology and analyzing whether it met the objectives, proposing an intervention to improve classes with practices accessible to schools and teachers, at low cost, through a descriptive study that is characterized as an experience report. For this type of research, they point out that:

> Researchers who use qualitative methods seek to explain the why of things, expressing what should be done, but they do not quantify values and symbolic exchanges, nor do they submit to the test of facts, because the data analyzed are non-metric (elicited and interaction) and use different approaches.[4]

The setting of the present research is a public high school in the city of Feira de Santana/BA, at night. The participants of the research were high school students in the evening period of the EJA modality of Axis VI, working with the class that was attending together 1st and 2nd year.

The research was applied from the regency internship in Biology II at the Immaculate Conception State College. With the change in curriculum based on the new High School, the schools adhered to this change and the discipline of Biology became Natural Sciences, containing itineraries to which they give the possibility of applying the practice of Biotechnology, since it is a multidisciplinary science. However, the EJA modality did not present itineraries, but disciplines, to which the research was carried out in the discipline of Biology equivalent to that of high school.

This research was initiated through research and bibliographic reading on biotechnology, low-cost practical classes, DNA extraction for purposes and understanding more about the theme to be investigated and was done until the moment after the execution of the practical class.

The elaboration of the practical class script and lesson planning was based on the practical classes of the disciplines Molecular Genetics BIO160 and Biochemistry BIO465 of the State University of Feira de Santana of the Licentiate Degree in Biological Sciences, adapting low-cost materials more accessible to the school and teachers, as well as glassware and other materials. adapting to the context that would be inserted. This script contains information with the steps of the methodology, the low-cost materials for extracting DNA from plant cells and the glassware that can be used, so that students can orient themselves and be able to carry out the practice in the school space.

A class observation was carried out by the teacher of the institution, which had the purpose of analyzing the behavior and development of the students involved in relation to the teaching method adopted by the teacher of the institution, thus knowing the class to which the methodology would be applied, presenting to the students the idea of the project as shown in the appendices on the right to choose to participate in the research.

With the elaboration of the lesson plan and having already chosen the class of AXIS VI, the one chosen was the one with the smallest number of students to whom the methodology was applied. The didactic sequence had a total of four meetings, with the first three twinned classes lasting 60 minutes and the last meeting being in only one class lasting 30 minutes. When the class met, only three meetings were planned, one to get to know the class, the second to explain the content and the third to apply and discuss the practice, but four meetings were necessary for a better organization and management of time and content.

The practice was carried out in the school environment itself, in the classroom, with DNA extraction from plant tissues, covering the basic and essential concepts about the conceptions related to the study of DNA through a dialogue with the students.

To conclude this research, the data collection was done through a logbook that was written as a result of the dialogue after the moment of class of practice with the students, where an experience report was built in order to identify the development and performance of the students in relation to the subject, about the teaching methodologies seeking to know if investing in

alternative methodologies with the use of low cost practices is feasible and if rescue the students' interest in the teacher/student experience.

The experience report focused on the teacher's performance in the practical class, the importance of the practices for the student's learning and participation in the practice and the lengths of the research objectives.

Results and Discussion

The DNA extraction class is important because in addition to students acting as the protagonists, it also shows that DNA is present in all living beings; It's something that can be seen and also exploited in order to get some return. The plant cells that contain the genetic material that we know as DNA, allow us to be used as a practical class because they have a great diversity of plants that can be used, thus making it accessible to the school and also to the teachers. This practice applied to high school can also serve as a basis for students to identify with their future professions, since in biotechnology DNA extraction can be applied to genetics.

Through class observation, it was noticed that the behavior of the students changed when the class did not have writing on the board, they were dispersed, talking, leaving the room, when some activity was passed.

In the internship, in general, it was noticed that when the subject was put on the board, a large majority remained concentrated and copied what was passed, because the schools did not provide them with any type of didactic material to support them. Soon they had to write down what was passed on to them in order to have a place to study. The school, because it had the EJA modality, the discipline continued biology, not divided as in other schools, such as natural sciences. This allowed for flexibility of content and better management of class time, since there were two twinned classes with a total of 60 minutes per week. The class in which it was worked contained students aged 18 to 44 years and an average of 20 to 25 students per class.

When teaching other contents before the application of the research, it was realized that many recurring terms in biology from cells to DNA became complex for them, many of them had never heard of these terms and much less knew the meaning, so these terms needed to be repeated more frequently citing examples. Teaching genetics can be tricky due to its nomenclatures, but there is a viable solution to this gap:

> Some biology terms are more complex and need extra care and adaptation in the language when being passed on to students.[1]

When working with genetics with the EJA target audience, it was necessary to make a review of the subject, bringing only more important and more striking characteristics, because it was observed that when the writing on the board became too extensive and became boring for the students, where many complained of fatigue because in addition to the routine of studies, they had other routines such as working, taking care of the house, children and this generates exhaustion, so they went to school with less energy and got tired very easily.

It was necessary to learn how to create a new strategy to attract the students' attention and facilitate learning, bringing the subjects in a clearer, more objective, succinct way and linking them to their daily lives, instigating their participation in the class at all times, walking around the room, following the writing in the notebook, answering questions individually and collectively in order to provide greater interaction.

In the first class of the didactic sequence, which began with a dialogue with the students asking about different organisms, which we had previously studied, what was the structure that is present in both and that was also present in us, human beings, animals and plants. After a few minutes, some students were able to guess that the structure we were talking about was DNA. At all times, I tried to maintain an interaction with the students so that they would not be scattered, instigating them about the subject in question. It was soon explained that the subject of our class would be about Nucleic Acids, many said that they had never heard of it.

The main characteristics of Nucleic Acids, as well as their function, structure and types, were discussed in the table. Even bringing up the subject in a succinct way, the students complained about the amount of things to write on the board, as they were not used to writing much. After the explanation of the content there were many doubts, many students commented that they could not understand anything that had been explained and that they need more time and more explanations to understand the theme. For this reason, teaching genetics due to language and terms becomes difficult.

> Genetics is a topic that is present in people's daily lives, however, due to its complex terms, it ends up making its study difficult. The lack of contextualization of contents, leading students to a strictly theoretical approach, hinders the teaching-learning process. Therefore, working with themes related to Genetics in the classroom allows experiences that enable the contextualization of the subject, associating it with everyday situations. [1]

The second class was planned to start with the introduction to DNA and Biotechnology in everyday life, but as the previous class on nucleic acids generated many doubts which due to the short period of the twinned classes did not have time to be clarified on the same day. And it started with the most succinct explanation about nucleic acids, as requested by the students to whom they asked to explain the subject again and that with time and activities they were learning more, focusing on DNA, addressing its characteristics and structure.

Because it is a dialogued class, it was always seeking interaction with the students, since this term "nucleic acids" they do not see much in newspapers and on social networks. After all the doubts clarified and the subject explained totaling a 30-minute class, the second moment of the class became more interesting for the students because they were able to see the applications of biotechnology and DNA.

This moment occurred as follows, as they are used to writing on the board and it was always requested, the theme of the class DNA and Biotechnology in everyday life was written on the board and distributed to each student a letter sheet that contained a name with an area of biotechnology activity, the sheets when distributed were turned down from the desk thus generating a curiosity,

Each one turned their page and volunteered reading the area of biotechnology that was on paper and talking a little about what they knew about it, there were students who did not know how to answer but were not embarrassed because everyone was participating and contributing to the collective knowledge, so each one read and said what they thought about it, others are also able to make associations with everyday life and for each one I explained details about the area. Among the areas that were mentioned we can mention cloning, tissue culture, production of cosmetics, production of vaccines and medicines, food industry, genetic engineering and so on, many of these areas were in their daily lives and due to lack of knowledge they did not realize it. The students in this class became the protagonists of their own knowledge as well as in the later class, the difference is that this class was a dialogued class that stimulated them to think about the theme and how it is in the daily life of each one of them.

The third class was divided into two moments: the first moment was the practical class with a simplified DNA extraction experiment because it took longer. The class started generating an expectation in the students because they had never done a practical class neither in science nor biology until that moment, the number of students on this day was lower than in previous classes, containing only 10 students, so the room was divided into two groups containing five students in each group. After the division of the groups, there was no way for the script to be printed, so the script of the practice containing the materials and methods was written on the board of the classroom, where some students by habit wrote in their notebooks.

It had been planned for this class that the room had been divided into four groups of five students, but on this day there was a lot of evasion, many times when working with EJA you need to deal with the uncertainty about the students' attendance, about the disposition when you propose something that is not used to their reality and encourage in the interaction and in the methodologies are to be adopted, Because many of these students are workers, housewives, housewives and workers and mothers, so they are people who often arrive in the classroom unwilling and alternative methodologies can stimulate concentration and learning.

Another difficulty faced was in the material for DNA extraction, in the script of the practical class it was proposed the extraction of bananas and strawberries. The choice of strawberries was because it is a soft fruit which would facilitate maceration, its color due to its pigment to compare the result during the experiment with other groups and because they have a lot of DNA in their composition, that is, inside their cells, since they have eight copies of the set of chromosomes. thus being considered octoploids. However, the strawberry is a fruit that when bought needs to be refrigerated soon because it tends to ripen and rot, for this reason for a practical class it cannot be bought much before the date of extraction. Due to the previous week having followed Easter, this fruit and its high consumption in the preparation of sweets, was in short supply in many fairs and supermarkets in the region.

The alternative was to work with the other fruit that is often used by teachers for this practice in the classroom, which is the banana, the banana that was used is from the backyard banana tree, without the use of pesticides or fertilizers, the banana is popularly known as water banana and scientifically called Typhonodorumlindleyanum, Having a yellower fruit color than the

bananas found in the market and a greenish skin, even the ripe fruit, while riper, the peel tended to be darker due to the presence of ethylene, which favors the ripening of the fruit. This banana tree is located in the city of Feira de Santana, in the Conceição I neighborhood, in the same neighborhood as the school where the research was carried out.

After writing on the board the script of the practice and the groups already divided, the materials were distributed so that the experiment could begin to be done, there were students who participated in all stages of the extraction and there were others who participated in one and were more observing and helping. The first step was to put the water in a plastic container, adding the salt until it became a homogeneous solution and then the detergent stirring slowly to create as few soap bubbles as possible, which this solution is called lysis solution, which needs to be done in the correct way to obtain extraction. The two groups started the experiment at the same time and the members of each group interacted with each other and with me, answering questions. The mashing part of the banana was easy, because it was very ripe making it easier to knead, but there was a student who due to the color of the banana peel is darker thought it was rotten and when removing the peel they could see the fruit only ripe. Both groups mashed the bananas by hand and instead of using the spoon or fork provided, it was left free for them to do as they saw fit.

After the banana was well mashed, it was time to transfer it to the lysis solution and stir until it reached homogeneity. All the stages of the extraction were done by the students willingly, attentively and following the script of the practice that was written on the board. When it came to transferring the solution to the filter to strain, leaving only the most liquid part, one group did it more calmly and did not need to be repeated, another group that when it was time to move the filter to strain, the filter ended up tearing and this process had to be repeated, but repeating correctly not disturbing the result. After the solution was already strained, it was time to add the alcohol at 96º ice cream and wait for the DNA concentration to accumulate on top of the substance.

As soon as the participants poured the chilled ethanol into the banana extract, they noticed the very thin white strands of DNA, which began to form and enlarge over time as they formed at the interface between the two layers. By stirring the DNA that formed in the ethanol layer, it formed fibers like those of cotton, making it easier to see. Porém este processo leva tempo e uma boa parte da aula já tinha se passado. As the class was about DNA and I had already done in the previous class the explanation and the design of the structure and the representative design of the DNA, they were taken to some DNA strands that were built through the DNA strands because it is flexible, being able to show the movements that it can make to be compressed inside the cell and representing the nitrogenous bases the green and purple grapes and jelly beans in color yellow and green, each of the bases represented were paired according to the DNA model and to bind these bases which is the hydrogen bonds was represented by toothpicks. This part of the lesson made the students amazed how food could be associated with the subject, being able to visualize the flexibility of DNA. While the students were waiting for the DNA to concentrate on the solution, it was time for them to have a moment of microscopy, for this moment slides were prepared with the epidermis of the apple, purple grape, and banana, seen in a lens of 40 and 100 times, where they could see that in a small part like the cut there were

many cells, And all the time being explained that just as plants in humans have many cells and that within these cells contains the genetic material, so they also noticed the difference in the pigments that each slide had. Many of these students said that the part they liked the most was the microscopy because they had never had contact before and they were looking forward to this moment. Another difficulty faced was that in the class that the students interacted the most, participated the most, were interested, the class went by quickly for me and for the students, not giving time to fully observe a large amount of accumulated DNA and discuss the performance of the class. For this reason, a last class was necessary for a chat with the students about the stages of the previous class. For this dialogue it was not necessary to use two twinned classes, one was enough to bring the students back.

The fourth class was the closing of the didactic sequence, which served to see if the students had absorbed anything of the theme worked. It was a dialogued class where he sought interaction with the students, in this class it contained a higher number of students than in practice, so the only ones who were able to respond were the students who were present in the third class. Questions were asked such as: What is DNA? Where is the DNA? Can we see DNA with the naked eye? What is DNA used for?, and all these questions the participants were able to answer correctly without the aid of a notebook, proving that the methodology was effective and facilitated their learning. Questions about the feedback of the methodology adopted in this didactic sequence with the use of content-based class, dialogued and associated with daily life and practice were asked and obtained positive feedback, where all students said that in this way they were able to learn more, that it became a more interesting and less tiring class, that they needed more classes like this, made the research successfully meet its objectives.

Faced with this problem faced by EJA students with the lack of didactic material and lack of methodological diversity in teaching, this exchange of experiences in the classroom has become indispensable for these students and for the teacher to be aware of the need for the contents to be worked on to go hand in hand with the students' daily lives. In this way, they can relate theory to practice in a more dynamic and productive way.

The enthusiasm and interest with the involvement of the students in all stages of the didactic sequence was noted, bringing positive feedback to the type of methodology chosen and the accessibility of the low-cost practice, which can be done in the laboratory and in the classroom as it was done. Regarding the difficulties faced in Basic Education, this form of methodology proved to be productive, since it enabled a space for discussion and exchange of students' experiences associated with their daily lives. The acceptance of the proposal by the research participants was also notorious, who were extremely interested in participating in each proposed moment and in discussing the theme.

Methodologies like this encourage students to act as reflective subjects and active protagonists of their own teaching-learning, leaving aside the role of spectators, because the teacher is in the classroom to add and not to transmit content, because these students, especially from EJA already have an experience and through this they bring with them the learnings that can be added in the classroom.

Conclusion

The idea of this work is not to devalue the standard teaching model with practical classes, but to be able to provide new didactic experiences at low cost, becoming accessible to the teacher, to the students and to the school, associating it with the theoretical class, connecting theoretical and practical knowledge, expanding knowledge and making the teaching experience more pleasant.

This didactic sequence served to demystify the view on the contents of genetics that tend to be "more complicated", thus helping students to understand and become familiar with the contents.

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