

Previous Conceptions of Students on Virology and Biotechnology: The Need for the Understanding

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ABSTRACT

Biotechnology is known as the set of processes and techniques that involves the manipulation of living beings, resulting in the production of a series of products useful to humanity. Virology is a science that studies viruses, sub-viral particles and prions and has enjoyed the benefits of biotechnology. However, although there is an increase and improvement in the productivity of goods and services including this area, the harmful potential of the virus is still highlighted, which favors the construction of negative conceptions that may make it difficult to learn subjects related to these beings or about Content in science, such as biotechnology. The theme Biotechnology and virology in high school is addressed, throughout the different series / years, in disciplinary contents that have a direct influence with the students' daily life and that, if well understood, can contribute to the improvement of their quality of life. Considering that students have knowledge prior to formal education and that such conceptions may become obstacles to the acquisition of new knowledge, this work sought to elucidate, through the application of a semi-structured questionnaire, the knowledge that high school students of a school State of São Gonçalo (RJ) have on topics related to biotechnology and virology. The results showed that students use a lot of information acquired in formal education, in the media and in social relations on the subject evaluated. It was evidenced a predominance of previous conceptions and little knowledge about the viruses and the biotechnological context present in our daily life through the use of products and services

KEYWORDS: Prior Conceptions, Biotechnology and Virology

INTRODUCTION

The term "alternative conceptions" or CA has received several denominations over the years, some with negative connotations (GIORDAN and DE VECCHI, 1996), others neutral. These conceptions have already had other denominations including preconceptions, conceptual errors, misconceptions, previous ideas, spontaneous theories, students' sciences, spontaneous conceptions and previous knowledge (ASTOLFI, 1988;).

School education has been ineffective in getting students to construct concepts that are scientifically accepted. Since the beginning of the CA studies, it has been realized that these researches can contribute to the promotion of new teaching strategies, involving the scientific knowledge and the reality of the students (DRIVER & EASLEY, 1978; MORTIMER, 1995; OLIVEIRA, 2005; MEMBIELA & CID, 1998).

Currently, there are more than 1000 published works involving the analysis of previous conceptions in different areas of knowledge, such as chemistry, biology, physics, geology, mathematics, Portuguese and other pedagogical disciplines. In publications involving biology various topics are covered: environment, biodiversity, hydrological cycle, greenhouse effect, evolution, origin of life, nutrition and obesity, Human body systems, photosynthesis, microorganisms, cell cycle, genetics, transgenics, health, phenomena Of nature, among others, (JIMÉNEZ, 1987; MENINO & CORREIA, 2001; SUGAHARA, 2001; LOPES, 2007; LIBANORE & OBARA, 2009; MENDES & CARDOSO, 2009; SEPÚLVEDA, 2009; FERNANDES, 2011; ANDRADE & TALAMONI, 2013; OLIVEIRA, et al, 2013; RATZ, et al, 2013;

SANTOS, et al, 2013; SILVA, et al, 2013). These publications have contributed, more than any other study, to breaking with the stagnation of a non-critical tradition and to initiating the problematization of the teaching / learning of the sciences (GIL-PEREZ, 1994).

Teachers should better understand the different existing knowledge, knowing that scientific knowledge - a systematized knowledge that seeks to explain the order of natural or social phenomena rationally presented in a scientific language - differs from school knowledge (teaching content To be transmitted to the new generations) and the knowledge (DOMINGUINI, 2008). It is up to the teacher to organize and adapt scientific knowledge in a pedagogical way, so that it can be taken and applied in the classroom, transforming into a school knowledge, allowing the students to have a confrontation of previous knowledge with the scientists and students, guaranteeing A possible success in teaching-learning.

There are currently few studies in the literature on previous conceptions with high school students (MS) involving biotechnology and virology. The engineer Ereky K. (1919) was the first to define the word biotechnology as: "science and methods that allow the production of products from raw materials through the intervention of living organisms." This definition is in line with Madigan's (2010) proposal, which more simply and comprehensively defines biotechnology as the use of living organisms for industrial or commercial purposes.

Biotechnology has been used by humans for thousands of years without proper knowledge about their agents. However, it is now known that through these processes and techniques with manipulation of microorganisms it is possible to increase and improve the productivity of goods and services, either through the food we consume or the drugs we use to fight various diseases (XAVIER et al. AI, 2009).

Virology is a science that studies viruses, also addressing subviral particles and prions, being intrinsically related to microbiology, molecular biology and biotechnology. Viruses are the simplest microbial forms. This is a molecular arrangement made up of a genetic material, which may be DNA (deoxyribonucleic acid) or RNA (ribonucleic acid) surrounded by a capsule protein. Some viruses can still be enveloped, presenting a lipid bilayer from the host cell that involves the nucleocapsid (STEPHENS, et al, 2010).

The study of virology has great relevance, since viral diseases affect a great part of the world population and can cause the death of several individuals, being an extremely important subject from the perspective of biotechnology (STEPHENS, et al, 2010).

In order to understand the processes involved in biotechnology, it is necessary to distinguish the different conceptions that involve this theme and are contained in different academic curricular disciplines (eg molecular biology, biochemistry, chemical and biochemical engineering, Immunology, physiology, genetics, materials sciences, computer science and microbiology), including previous conceptions (DRIVER & EASLEY, 1978, MORTIMER, 1995, OLIVEIRA, 2005, MEMBIELA & CID 1998). Therefore, it is important to know the concepts, applications and implications of biotechnology, whether involving health (vaccines, production of biopharmaceuticals, creation of therapeutic substances, paternity testing, genetic engineering, diagnostic materials such as prenatal, cloning), Agricultural (using transgenic), industrial (biocatalysts producing biofuels) and the environment (waste, sewage and water treatment). These themes are part of the repertoire that affects mankind as a whole and each individual in particular, influencing ethical, political and economic decisions (DELIZOICOV, et al, 2002). Considering the need for a teaching-learning process that goes beyond the mere transmission of knowledge promoted by a traditional teaching vision, the objective of this work was to analyze students' conceptions about biotechnology and virology, as well as their activities And applications, in order to contribute to guide and promote learning with a greater meaning and efficiency in the school environment.

METHODOLOGY

Audited public

The CIEP Brizolão 239 - Professor Elza Vianna Fialho is a state school located in Vista Alegre, an urban area of the Municipality of São Gonçalo - RJ. In this study, 1st, 2nd and 3rd grades of the MS of this school participated, with a total of 172 students, ranging in age from 14 to 20 years.

Instrument and form of evaluation

The data of this work were obtained through the application of a semistructured questionnaire (Appendix 1) with the purpose of analyzing the students' conceptions on the themes: Biotechnology and Virology. It is worth mentioning that this work is part of the Extension Program "School of Inclusion" of the Fluminense Federal University.

The students' responses to qualitative questions were evaluated through Content Analysis (Bardin, 1997). In addition to qualitative questions, the questionnaire included quantitative questions, including those of the type: open (without alternatives, reducing the risk of the interviewee being influenced by the alternatives presented), closed (with options of answers, of which the interviewee can choose one or more alternatives) and multiple choice, being a promising approach for the interpretation of the quantitative data, allowing the establishment of categories to group these data and the hypothesis of their meaning (CRESWELL, 2007). The evaluation instrument contained 10 questions organized to investigate the profile of the groups in relation to knowledge about virology and biotechnology, and opinion questions, with the purpose of probing the positioning of the students in relation to certain subjects. Five of these questions are on virology in a generalized way and the other five on the opinion of students about the importance of virology, biotechnology and ways of improving teaching.

The five questions involving virology are multiple-choice, being: 2 questions with multiple alternatives, with no excludable answers - where next to the question there is the phrase "mark as many as you want" - explaining this characteristic; And 3 questions with exclusionary alternatives, where beside the question stood the phrase: "mark one".

From question 1 to question 5, except for question 3, did they all have the "I do not know" option, so that students would not feel compelled to answer something (kick) and only mark that option that really Agree.

Of the five questions of opinion, three present the need for discursive justifications. Of these, two previously have a pre-answer (YES or NO) for the main question.

The questionnaire (appended at the end of the present study) was applied in February 2014 in the school environment, where the students were invited to participate in the research in the time of Science and Biology classes in the presence of their teachers. Therefore students were in the 1st Bimester of the academic year, where according to the Minimum Curriculum, the biotechnology theme is not taught at any time since the student's entry into the school environment, while virology theme is highlighted in the 7th and 8th grade Of Elementary School (EF) and in the 2nd and 3rd grades of High School.

Respondents were asked to respond to the questionnaire in a calm, responsible manner, with a time limit of 40 minutes to answer the questions, but they were also warned that they would not be making an evaluation or proof.

RESULTS AND DISCUSSION

Question 1: What are viruses?

Figure 1 presents the results of the answers regarding question 1, which aims to evaluate the students' previous conception regarding the concept of virus. Among the 6 alternatives, "Compulsory intracellular

parasites" presents a more complete concept while the only one wrong is "They are part of the fungi and bacteria group". Analyzing the question regarding the three distinct series of MS, it can be observed that the third grade had a lower "completeness" index (28.3%) than the first one (37.8%) and the second grade (50%) (Figure 1 A). However, 42% of the students believe that the viruses are "compulsory intracellular parasites" and are considered a relevant percentage, although 30% of the students believe that these organisms "are part of the fungi and bacteria group". Studies show that many students associate viruses as part of the same group of bacteria and fungi, as organisms are mostly disease-causing and microscopic. This infers the construction of previous conceptions influenced by different media and other sources of information to which the students have access in their daily life, such as: internet, television programs, newspapers, debates, living with family, friends and With society.

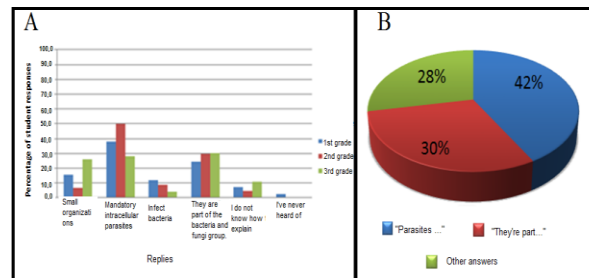


Figure 1 - Answers to Question 1 - What are viruses? - of the high school students of CIEP Brizolão 239 - Professor Elza Vianna Fialho. A) Distribution of answers according to the high school series, B) Incidence of complete answers (Parasites ...), incorrect answers (They are part ...), and other answers.

Misconceptions such as those observed in this work compromise the student as a student subject and according to the literature, a misconception like this about the virus, bacteria and fungi being part of the same group should conflict with other conceptions in the school environment so that there is a learning (RAMOS, 2010). This type of conception also compromises the individual as a citizen, since knowing how to distinguish these beings can help to take precautions and opt for appropriate treatments, discarding wrong options such as the use of antibiotics for the treatment of viruses, which prevent the emergence of bacterial resistance, a long-term solution to the global problem, except for the rational use of the drugs currently available to the population.

Question 2: Do viruses infect ...?

Figure 2 presents the results of the answers regarding question 2, which intends to evaluate the students' conceptions about the possible viral hosts and how they have been explored by the teachers. In this question, there is no wrong answer, distinguishing itself only by the degree of complexity. It should be noted that the 2nd year of MS seems to have a better judgment of the issue, which may indicate a better mastery of the subject, followed by the 3rd year and 1st year (Figure 2).

Viruses can infect different organisms like bacteria, being recognized as bacteriophages; (A, B, et. Al., 2009). In addition, Amabis and Martho cite in their books (Biologia, 2004) for MS and other references (Stephens, et al., 2009). In the overall assessment, 60% of the students noted the "All Cited" response, inferring a deeper understanding of the correct scientific knowledge in this area, knowing that viruses can infect bacteria, plants and animals. However, as observed in figure A of Figure 2, some students had doubts about the presence of these viruses infecting plants. This may be due to the lack of daily information on the numerous functions or "performances" of viruses in the environment, as described in the Green School Project (CARDOSO, 2012).

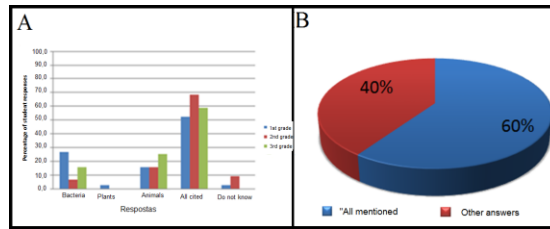


Figure 2 - Answers to Question 2 - Viruses infect ... - CIEP High School students Brizolão 239 - Professor Elza Vianna Fialho. A) Distribution of answers according to the high school series, B) Incidence of complete answers (All cited) and other answers.

According to Cardoso, this can be explained by increased concerns about public health issues that lead the media to disseminate more information about human infectious diseases and agents and less information about the harm and benefits generated by the manipulation and intervention of viruses in the environment Interacting with other living organisms, such as: vegetables, wild animals, marine animals and even invertebrates.

Question 3: Which of these diseases are caused by viruses?

The results of question 3 that aimed to evaluate students' knowledge about diseases caused by viruses and other microorganisms and the importance of this knowledge to public health are shown in figure 3.

Of the 10 reported human diseases, only five (AIDS, Dengue, Flu, Chickenpox and Herpes) are caused by viruses while pneumonia can be caused by viruses and bacteria (FIGUEIREDO, 2009). The other human pathologies (Tuberculosis, Ringworm, Cholera and Candidiasis) are caused by other microorganisms such as bacteria and fungi. Most of the students analyzed believe that viruses are responsible for "AIDS" (21%), "Influenza" (20%) and "Dengue" (12%), followed by the misconception that Tuberculosis, Canker, Ringworm, Cholera and Candidiasis are also caused by these beings.

One hypothesis for this result may be that since the 8th year of elementary school students have already heard about virology and human pathological diseases on the part of the teacher and in the textbooks (LINHARES, 2004; AMABIS and MARTHO, 2004). As required by the Minimum Curriculum and in the National Curriculum Parameters (NCP) (BRASIL, 1998).

According to the literature, throughout the series the presented concepts can be forgotten, confused or replaced by other erroneous ones. In presenting a concept that some bacterial or fungal diseases are caused by viruses, students confirm what Calértti (2007) states, where people correlate a negative view of viruses with diseases with the highest rates of occurrence in Brazil. This idea is wrong and must be eradicated from the population, because organisms like protozoa, fungi, bacteria among others are also responsible for most of the diseases of great occurrence.

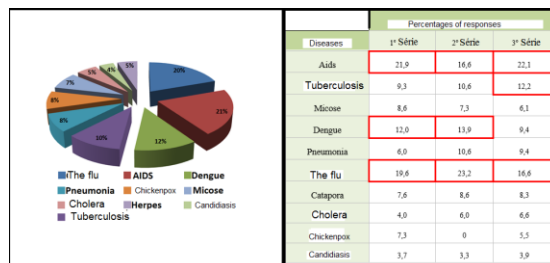


Figure 3 - Answers to Question 3 - Which of these diseases are caused by viruses? - of the high school students of CIEP Brizolão 239 - Professor Elza Vianna Fialho. Overall incidence of responses (above) and specific distribution of responses according to the high school grades (below).

Question 4: What do you do when you suspect you have a viral illness?

Question 4 aims to evaluate students with regard to prophylaxis of viral diseases (Figure 4) presenting only one correct alternative (I go to the doctor) at the high school level. Thus, interestingly it is possible to note that 55% of the total of the analyzed students agree to choose to seek the doctor to be diagnosed and treated correctly.

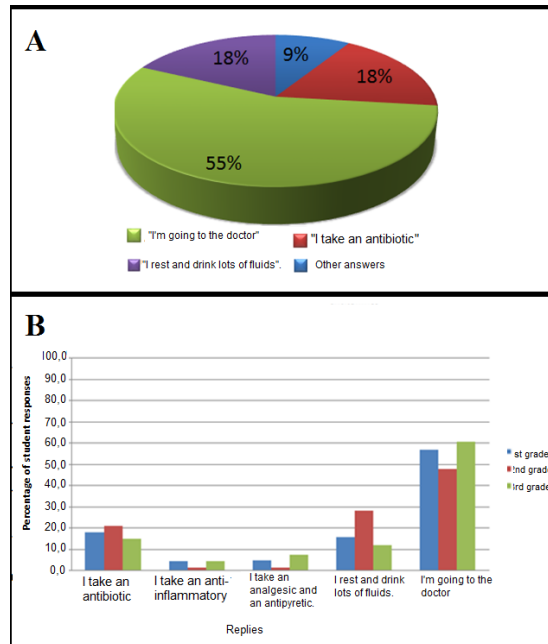


Figure 4 - Answers to Question 4 - What do you do when you suspect you have a viral illness? - of the high school students of CIEP Brizolão 239 - Professor Elza Vianna Fialho. A) Incidence of answers, B) Distribution of answers according to the high school series.

Although the choice of correct response is expected, since students would possibly have a view of the virus as a public health problem and would choose correct prophylaxis, another 45% of students would not proceed in the same way. This index is relevant, and can be explained by arguments similar to that of question 1, because if the student or an individual of any age group does not know the type of pathological agent, consequently he is not able to proceed in the correct way in his treatment or mechanisms Against the infectious organism. This corroborates the idea of Libanore (2007) in which personal experiences are used by the individual to try to explain observed phenomena and their implications forming their conceptions.

The other responses most voted were "I take an antibiotic" and "I'm at rest and drink lots of fluids" attesting to a very common attitude in the population (WECKX, 2012), in which these choices can generate antibiotic resistance in bacteria. This finding indicates that students believe there is an association between antibiotics and viruses, which would be erroneous since antibiotics are only used to treat bacterial diseases, and there are few drugs for viral diseases.

Question 5: What do viruses do within our cells?

Figure 5 shows the results concerning question 5 on the "behavior" of the virus upon entering the cells. Of the five questions offered only "Multiply" would be the correct answer. According to the results observed, 75% of the total students chose "Multiply", and it can be observed that the second year of MS stands out with a greater number of correct answers.

The fact that in the student's conception the knowledge that viruses "reproduce" or multiply, replicating in plant cells, animals or other microorganisms, can be inferred that: a) the books are presenting (B) that there

has been a successful delivery of the classes and / or (c) the students would have chosen a response (eg, More viable and logical according to their conceptions, since these have already passed through the 7th and 8th year of the EF and that already have a certain knowledge about the performance of the virus inside the cell.

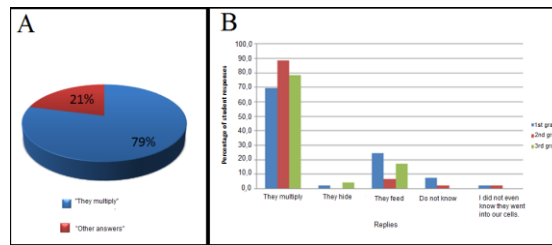


Figure 5 - Answers to Question 5 - What do viruses do within our cells? - of the high school students of CIEP Brizolão 239 - Professor Elza Vianna Fialho. A) Incidence of correct answers (multiply), B) Distribution of answers according to the high school series.

The fact that 21% of students present erroneous answers still seems to represent an inefficacy of school knowledge as a mediating element of the individual's thinking in the construction of scientific knowledge, represented by old conceptions where scientific knowledge and its explanations were not incorporated (LESSA, et al. , PEDRANCINI et al., 2008).

Question 6: Do you find research on virology important?

According to the literature, millions of people worldwide are affected by viral diseases, such as AIDS, with 35.5 million people infected worldwide, and HPV with approximately 20 million people infected in the world, among others . And there is a need for and extremely important knowledge building in virology (UNAIDS, 2012, PREFACE OF SÃO PAULO, 2008). In this study it was possible to observe, when analyzing the students' opinion, that the great majority of these find the studies involving this area very important (Figure 6). Understanding the importance of virology is essential for these students to be citizens who can demand from the government better treatment and outpatient and hospital care because they understand the extent and severity of this issue.

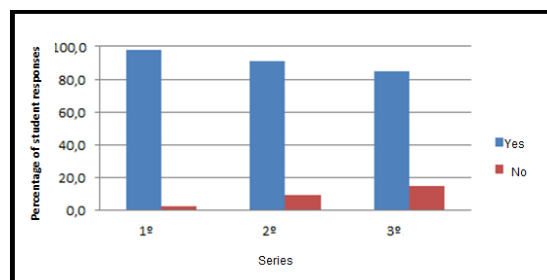


Figure 6 - Distribution of answers to Question 6 - Do you find research on virology important? - of the high school students of CIEP Brizolão 239 - Professor Elza Vianna Fialho according to the course series.

The most important justifications for this issue were:

"To discover new viruses"

"To find the cure of diseases"

"To increase knowledge in this area"

"For the creation of more specific antidotes"

"To prevent or prevent diseases that can cause death"

"Increase knowledge about viruses and understand how they act"

Question 7: Do you think students need to know about virology?

It is known that the study of viruses is important for increasing knowledge about the ways in which these organisms use the energy resources of their host cells, as well as clarifying various biological mechanisms, economic, industrial interests in health, reducing Viral diseases (NORKIN, 2010, CARTER, 2013, SINOOGAS, 2014). Figure 7 expresses students' opinion about the need to learn virology.

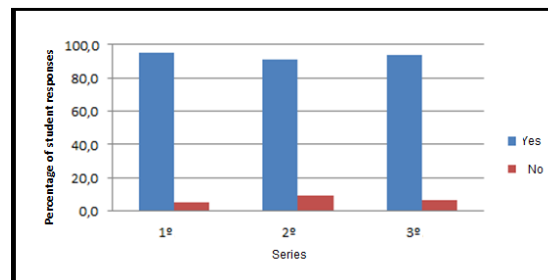


Figure 7 - Distribution of answers to Question 7 - Do you think students need to know about virology? - of the high school students of CIEP Brizolão 239 - Professor Elza Vianna Fialho according to the course series.

The most important justifications for this issue were:

- "To better understand diseases"
- "To adapt to the scientific world"
- "To prevent us from diseases caused by viruses"
- "To learn more about it and fight against viruses"

It is observed that the majority answered "YES" about the importance of virology and the patterns of justifications that are most frequently noted. Interest in virology with public health issues and self-knowledge is an important indicator that Students have curiosity and appreciation for this discipline, favoring the motivation to learn the content.

Question 8: Would you like to have a computer virology class with animations or board games?

When evaluating the answers to this question, it can be noted that more than 60% of the students are interested in classes taught with new teaching methodologies. According to several authors, biology is a science in which one can work with students in different ways (audio-visual, computational tools, laboratory practices and in the classroom) with dynamism, avoiding the sameness found in lectures. The use of numerous scientific terms, tables and cycles makes it difficult to understand concepts, requiring students to have a stimulus or different innovative methodological resources (such as games, debates, seminars, etc.) (KRASILKCHIK 2004, FREITAS, et al.

Question 9: Have you heard about biotechnology?

Biotechnology has been part of mankind since the earliest times, with the use of fermentation in the production of wines, breads among other products. It is now known that biotechnology can be defined in various ways and is accepted by the scientific community as "the use of biological processes (enzymes, living or synthetic cells) to produce goods (chemicals, food, fuel and medicines) and services. Biotechnology encompasses a variety of molecular and genetic techniques (MINISTRY OF AGRICULTURE, LIVESTOCK AND FOOD SUPPLY, 2010) using various organisms such as bacteria, plants, animals, viruses and protozoa. According to the analysis carried out in this study, students in the first year of the study institution seem to have heard more about biotechnology than students in grades 2 and 3. The results also show that more than half (52%) of students have heard of this science (Figure 8).

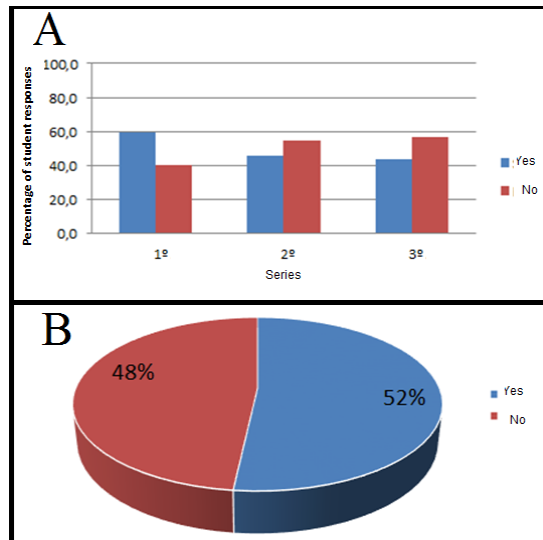


Figure 8 - Answers to Question 9 - Have you heard about biotechnology ?, from the high school students of CIEP Brizolão 239 - Professor Elza Vianna Fialho. Distribution of answers according to A) the high school series and B) general analysis.

Question 10: Do you know how to define biotechnology?

The students' answers about the definition of biotechnology (Figure 9) reveal that more than 80% of the students do not know how to characterize it, which reinforces the need to invest in scientific dissemination in this strategic area of science that can greatly contribute to the formation and Development of Brazilian society.

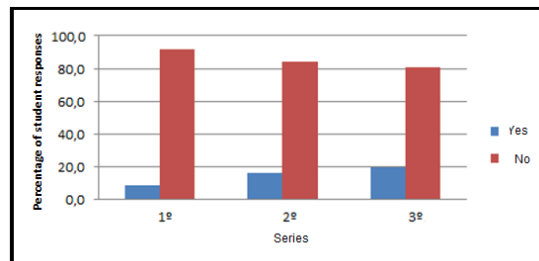


Figure 9 - Distribution of answers to Question 10 - Do you know how to define Biotechnology ?, of the high school students of CIEP Brizolão 239 - Professor Elza Vianna Fialho according to the course series.

The most common justifications for this issue were:
"Study of the technology of life"
"It is an advanced study of biology"
"It is the study of biology with the help of technology"

It is important to highlight the following answers, for demonstrating knowledge about the subject:

"It is the study that uses technology to analyze DNA from living beings"
"It is technology based on biology, and can be used in agriculture, food science and medicine."

FINAL CONSIDERATIONS

Teaching is not just about transmitting knowledge and the teacher's mission involves enabling the creation or production of knowledge (FREIRE, 1992). The purpose of the school is to prepare autonomous citizens who know how to seek information and transform it into personal knowledge, tools for thinking and acting in the social milieu in which they live, by describing their time and place (LIMA et al., 2008). According to the results and in agreement with the literature, it is still necessary to further reflect on the way in which the concepts related to virology and biotechnology are being addressed in primary schools, both elementary and high school. Apparently the teaching of these subjects in the school analyzed is considerably related to diseases and public health and virology is little explored on the campus of evolution and conceptualization of life. In this study, we observed that the students did not pay attention to the virus infection in plants, and only one issue of virology was considered, among many others.

It was observed in this study a great confusion on the part of the students regarding the viruses and bacteria, being able to influence in erroneous conceptions on morphology, cycles of "life", replication, reproduction, among others. However, our data indicate positively that there seems to be a progressive positive influence on the reconstruction of correct concepts on these different scientific subjects, since the higher the level of schooling and the students' contact with the contents developed in the school, more coherent were his answers in the surveys done.

It is hoped that the information presented in this paper can contribute to clarify students' conceptions about biotechnology and virology, as well as to demonstrate the possible integration of Microbiology contents with other areas of Biological Sciences. Thus, it is assumed that this work can be useful for the improvement of the practice of teachers committed to contextual and meaningful teaching, aware of the importance of considering the ideas that the students take to the classroom; As well as to contribute to the development of didactic materials that facilitate the understanding of subjects that require a greater degree of abstraction, in order to allow the construction of concepts compatible with scientific knowledge and that at the same time have a meaning in the life of the students, helping them in Decision making and consequently improving the quality of their lives.

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