

THE CONTRIBUTION OF THE HISTORY OF SCIENCE TO SCIENCE TEACHING – A STUDY ON THE REPRODUCTION OF LIVING BEINGS

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Abstract

We believe that the incorporation of the History of Science in education can provide students with a better understanding of the mechanisms of production and reconstruction of knowledge and contribute to preparing scientifically educated citizens and allow them to be able to make decisions about social issues based on personal understanding of scientific and technological processes about the world they live in. According to some authors the initial training of teachers of Biology / Geology, has not significantly valued the using of the History of Science as a teaching tool.

This study has as main objectives to identify the level of knowledge of the sample students as far as the reproduction of living beings is concerned; to contribute to a better understanding of the scientific contents based on the History of Science and to develop materials and teaching strategies based on historical examples. The methodology used was Research – Action. The sample consisted of 18 students who attended the 11th form in a school in the municipality of Vila Real - Portugal in the academic year of 2011/12. A questionnaire was used to collect data. The data collected in the questionnaire (pre-test and post-test) were treated by qualitative content analysis and compared with those obtained in another class - pilot class. The data showed that there was a significant level of acquisition and understanding of knowledge concerning the reproduction of living beings when the History of Science was used.

The knowledge of the History of Science allows us to understand the processes through which scientific ideas have been built and developed and have culminated in the current state of science. These new perspectives present new challenges to science teachers and require new approaches to their training, if we really want it to be effective and to result in better learning by students. We therefore consider it necessary to create opportunities for future teachers to reflect on the possible uses of the History of Science in order to implement it in their teaching practice.

Keywords: History of Science, Science Teaching, Reproduction of living beings.

1 INTRODUCTION

The History of Science is a motivating subject, but is also instrumental because not only is it an important tool for the science student but it may, in the near future, provide a means to help adjust students to an increasingly competitive society.

The current study was carried out in the Secondary School Camilo Castelo Branco, Vila Real, with a class of 11th grade students of Biology and Geology during the academic year of 2011-2012. This research aims to be a useful tool for science teachers, in the sense that it tries to establish a relationship between the use of the History of Science in the teaching and learning processes of students and the evolution of their scientific knowledge.

The study was carried out according to the following goals:

- To reflect on the importance of including the History of Science in science education.
- To assess the impact of the inclusion of the History of Science in science education as a tool for scientific training.

2 THEORETICAL FRAMEWORK

The History of Science can be a valuable educational tool that helps making science teaching more interesting and makes learning easier (Amador, 2010). From a practical and applied perspective, the History of Science can be regarded as a subject in scientific disciplines and as a teaching strategy that facilitates the understanding of concepts, models and theories (Martins, 2006). The inclusion of History of Science in science curricula can help students to have an in-depth background of the development of science, as well as to understand that what is written in books today will need to be changed in five years (Rodrigues, 2007). According to the same author, one important thing that History of Sciences teaches is that ideas about Nature change as we continue to question and imagine.

The few studies carried out in Portugal show that the History of Science is not included in science classes, indeed only some aspects of the "internalist" story of science are provided (Duarte, 2003). It is therefore essential to assign to the History of Science the standing that it deserves. After all, if this status is not established in time, the next generation of historians (and other scientists) may not be able to make history of what is recent to us and will be, to them, only a small part of the field of contemporary history.

3 METHODOLOGY

The scientific methodology chosen was action-research. The latter expression conveys a dual purpose of action and of research in order to obtain results through these different approaches: through action, we seek to achieve change in a community, organization or program; through research, we seek to increase the understanding by the researcher, the client and the community (Dick, 2000). Therefore, the methodology entailed the completion of a questionnaire related to the History of Science. The questionnaire was handed to the students at the beginning of the chapter on Reproduction, which is part of the Biology and Geology syllabus of the 11th grade. At the end of the unit, we handed the same questionnaire to the class under study to assess students' progress in this area. The questionnaire was also used in another class of the same grade, in order to provide a means of comparison between the two classes and assess the usefulness of the History of Science in improving the scientific literacy of students.

Throughout the teaching of the course we stressed the importance of the History of Science by referring to some relevant scientists that contributed to the subject under study, the difficulties related to the construction of scientific knowledge and the provisional character of the theories, principles or laws in science.

Subsequently, we performed an analysis and interpretation of questionnaires and converted this data into graphs for ease of clarity. The 11th grade class under study (class E) had 18 students, 13 of which were girls and five were boys; eight students had already repeated a year in primary school and one student had SEN. The average age of the class was 17 years. The academic performance of the class was rated as average. The 11th grade class used as control in this study (class B) had 15 students, of which nine were girls, six were boys, and its academic performance was considered good. The average age of class B was 16 years.

4 ANALYSIS AND DISCUSSION OF RESULTS

Contents of subparagraphs of Question 3

- a) Reproduction ensures the maintenance of life on Earth.
- b) Asexual reproduction is based on mechanisms of meiosis and fertilization.
- c) Reproduction results in offsprings that are clones of the parent.
- d) A sexual reproduction is ensured by the occurrence of mitosis.
- e) In the budding process there is formation of projections, the buds, which develop and separate yielding new beings.
- f) In parthenogenesis, there is formation of new individuals without the occurrence of fertilization.
- g) In multiple divisions one being divides into two beings with identical dimensions.
- h) In sporulation, there is formation of reproductive cells, spores, each of which may lead to a new individual.

- i) Reproduction always leads to genetic variability.
- j) In reproduction there is always involvement of sexual cells.

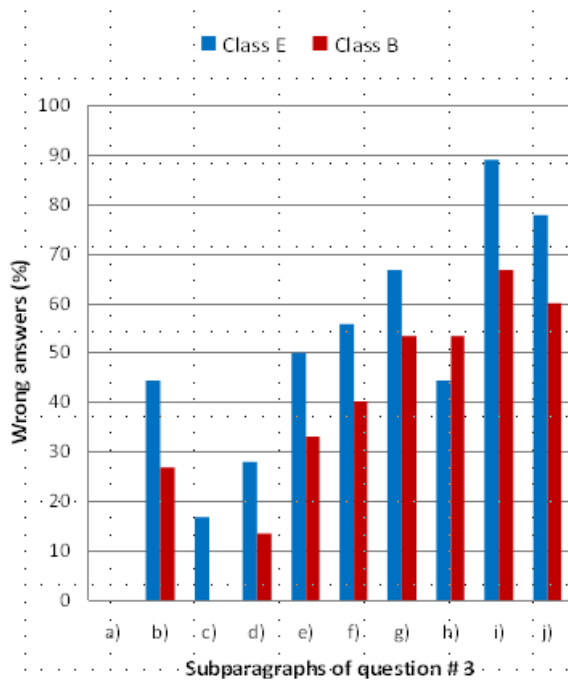


Fig. 1: Percentage of wrong answers to question 3 of the pre-test taken by classes E and B of the 11th grade.

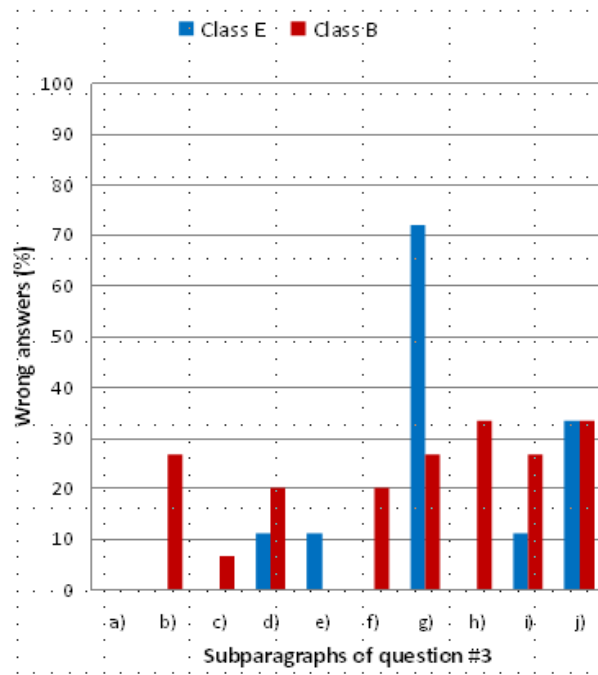


Fig. 2: Percentage of wrong answers to question 3 of the post-test taken by classes E and B of the 11th grade.

According to Figure 1, both classes of 11th graders showed a considerable lack of knowledge on reproduction. Both classes had a high percentage of wrong answers in the pre-test, in particular class E to which History of Science was taught.

Regarding the results of the post-test figure 2 shows that there was a positive evolution in the two groups. However, the most significant development occurred in class E of the 11th grade.

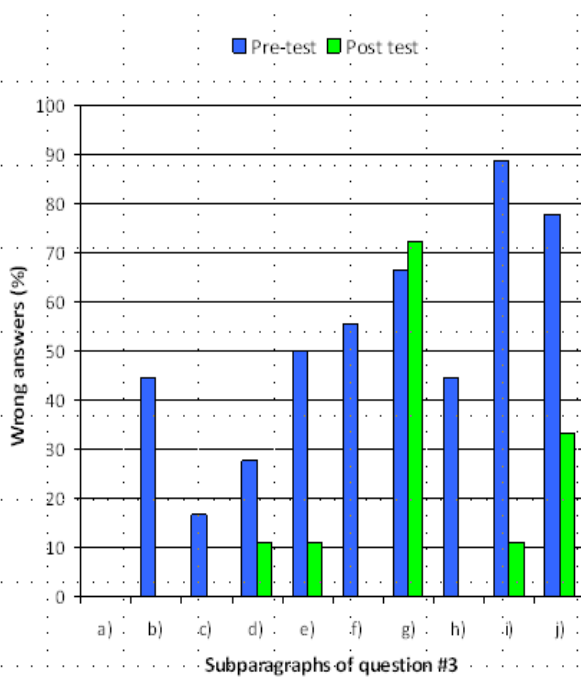


Fig. 3: Percentage of wrong answers to question 3 of the pre and post-tests taken by class E of the 11th grade.

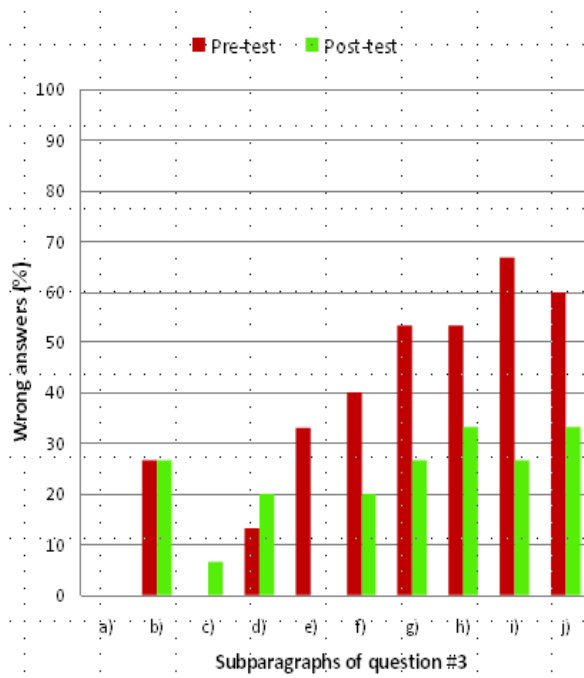


Fig. 4: Percentage of wrong answers to question 3 of the pre and post-tests taken by class B of the 11th grade.

Figure 3 shows the evolution of the class to which History of Science was taught; the percentage of wrong answers decreased sharply, revealing the effectiveness of the History of Science in scientific literacy of students.

In regard to the evolution of the control group (B) figure 4 shows that there was also an improvement, but not as significant as in class E.

5 CONCLUSIONS

The History of Science should be an essential aspect in the education of young people. Its importance has been recognized at the level of the curricula of Physical and Natural Sciences. However, most teachers do not include the History of Science in their teaching and / or their knowledge in this area is clearly deficient.

The results obtained in the group under study were very positive, in line with the Theoretical framework of the History of Science

Students have undergone a gradual evolution in the field of sciences, which helped to improve the aspects related to their scientific literacy.

Failure to include History of Science in science education shows the inadequacy of the measures taken and point to the need to update teachers' education, one of the main shortcomings highlighted in this study. This implies a rethink of teachers' training institutions, such as universities, but also of schools that must play the role of true institutions of training and innovation.

The diversity provided by the different stories and historical contexts in which students can take an active intervention can make science more attainable and motivating, contributing to the development of a deeper interest in science.

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