

Teachers' Training and History of Science: A Quasi-Experimental Study

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Abstract: *To prepare scientifically educated citizens able to make decisions about social problems based on personal understanding of science, is a responsible commitment of educational institutions that has traditionally been neglected. In this sense, some authors point to the need to create opportunities for, in their initial training period and even in future professional development, teachers to reflect upon History of Science. They are also instigated to use the History of Science in schools and applied it in their science teaching practices. In this paper we aim to discuss how the incorporation of the curricular unit of the History of Science as an optional unit in initial training courses for science teachers can help them to improve their scientific knowledge and be aware of its importance while future professionals. We resorted to a quasi-experimental study with a convenience sample, consisting of 56 students from some Teaching Masters in an university in northern Portugal. All of them attended the 14 classes of the curricular unit of History of Science. For data collection we used a questionnaire in a pre and post-test basis. The results point towards a significant improvement in scientific culture after the attendance of History of Science curricular unit.*

Keywords: *History of Science, scientific literacy, teachers' training*

1. INTRODUCTION

Over the past few years, science education research has shown the important role played by the History of Science in the teaching and learning processes (Martins, 2007). However it is still a much neglected curricular unit (Rodrigues, 2007; Vasconcelos et al., 2013). According to Duarte (2003), the integration of the History of Science in the teaching and learning processes stimulates questioning, creates new synergies and is a driving force in the advance of the teaching of science. That is, the History of Science can be used as a useful teaching device, helping to make the teaching of science more interesting and facilitating its understanding (Amador, 2010).

This curricular unit can and should be incorporated within the initial teachers' training (Rodrigues, 2007; Silva and Rodrigues, 2012) increasing the to further understanding of scientific controversy as, for example, the evolution of the human species or even the complexity of deep team (Vasconcelos et al., 2015). But the use of the History of Science in Science Education brings to the centre of the educational problems teachers' training. There is no point in changing curricula, if there are no changes in teachers training. They are the ones who will implement the curriculum and if they have no knowledge of the History of Science the curriculum implementation will be limited to a mutilated version of itself (Mathews, 1992).

It is therefore essential to create opportunities for future and current teachers to reflect upon the possible use of History of Science in as well as to recognize it as an important tool to improve their own scientific culture (Abd-el-Khalick & Lederman, 2000). This study rose with the purpose of analysing if the scientific culture of master students' could be improved with the teaching of History of Science.

2. METHODS

We made a quasi-experimental study with the application of a questionnaire with 9 questions (see appendix 1). The questions were elaborated by the authors of this article, and a preliminary study, after its validation by two experts in History of Science, was administrated. This preliminary study indicated that the results were consistent and that the instrument was reliable. The questionnaire was

applied before and after the teaching of 21 hours of History of Science, during in 14 classes of 1,30hour each. Our convenient sample consisted of 56 Teaching Masters' students from an University of the north of Portugal.

The teaching methodology applied implied a dynamic learning with diverse strategies resorting to PowerPoints presentations and discussions, and the elaboration of worksheets. A project-based learning was also encourage, so that small groups of 5 to 7 students wrote a document related to the development of science through centuries, emphasizing the most important discoveries and the most eminent scientists.

3. RESULTS AND DISCUSSION

When analyzing question number 1, we noticed an increase of the interest of the students from the beginning to the end of the classes. Moreover, the majority of students (more than 80%), had an interest in science, even before the application of the lectures.

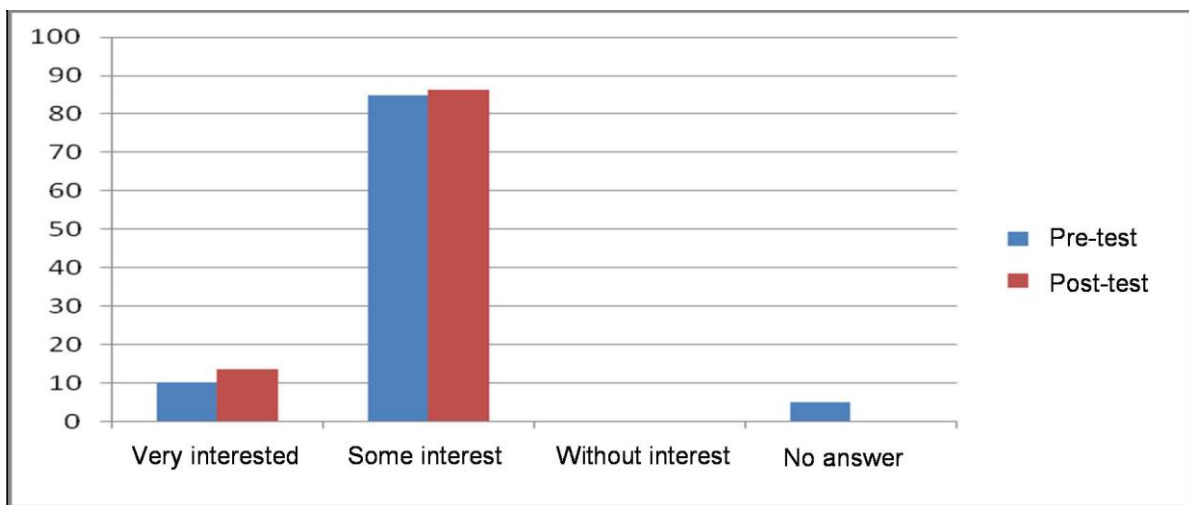


Figure 1 – Students answers about their interest regarding general science (scientific culture), comparing pre-test and post-test results.

In terms of answers to question number 2, in pre-test the majority of students only mentioned the most well-known institutions like, for example, NASA, Champalimaud or Gulbenkian Foundations.

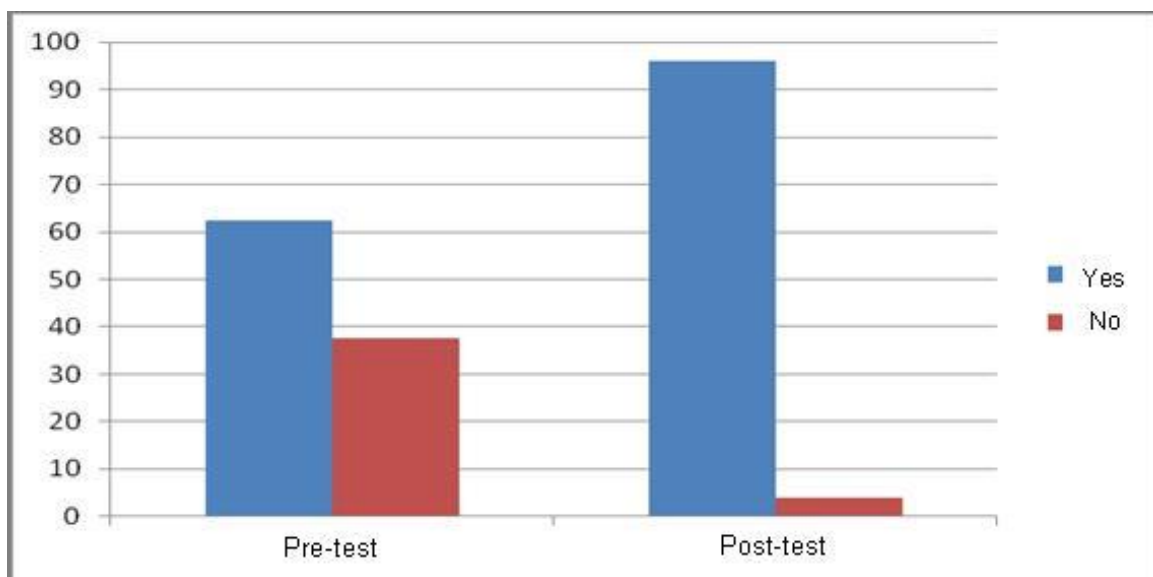


Figure 2 – Students answers about science dissemination institutions, comparing pre-test and post-test results.

Nevertheless we noticed that 38% of the students didn't name any institution at all. However, in the pos-test, about 96% of the students referred at least the name of one institution that promoted scientific dissemination, being their own University the most cited one. It is remarkable that only after the History of Science's classes did the students recognized their university as research institution with potential to popularize science.

Only 31% of the students answered in the pre-test when asked to recognize a Portuguese researcher that still perform his activity as a scientist. However, 45% of the students acknowledge that did not know his name, and 21% did not answer to the question. However, after the classes, all students were able to mention at least one name; being Professor Galopim de Carvalho the most cited one (57% of answers).

A better relation between the scientists and its discovery was found after the intervention. Names like Garcia da Horta e Amato Lusitano that only had 8% and 25% of answers during pre-teste respectively, increased to 92% and 96% in post-teste respectively.

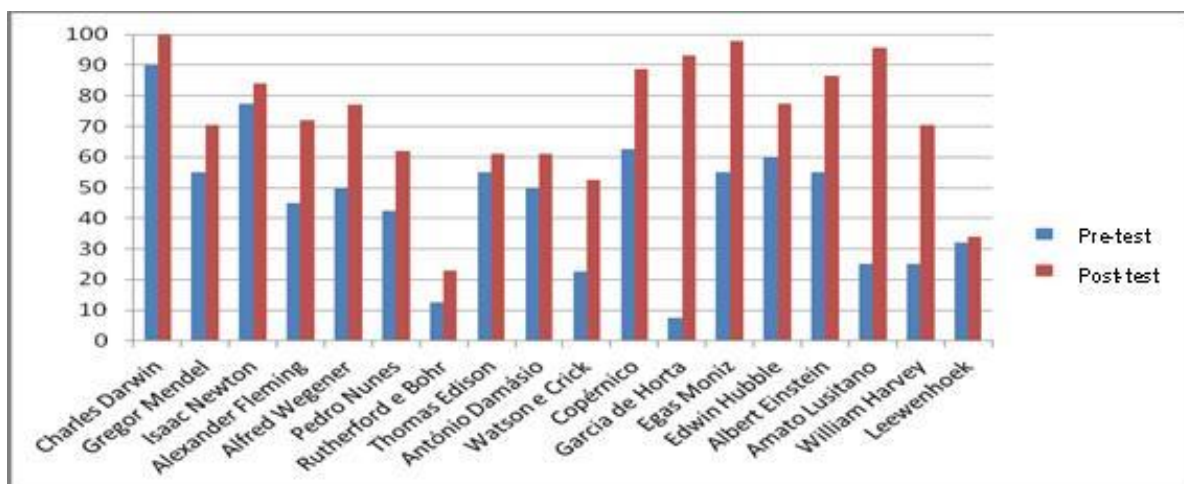


Figure 3 – Correct answers regarding the correspondences between researchers and their findings, comparing pre-test and post-test results.

During pre-test, 80% of the students evaluated their scientific culture as being very low or satisfactory, but after the 14 classes they considered that they had improved to a better notion about science, scientists, research and its dissemination.

After descriptive analyses of the questions we decided to give a score to the questionnaire, considering only the first 7 questions. A Wilcoxon test revealed a significant improvement in students' knowledge ($Z=3,96; p<0,015$) allowing us to claim that this curricular unit is important in teachers training and professional development.

4. CONCLUSIONS

Science curricula reorganization, namely in Portugal, had led to the introduction of a higher number of historical, philosophical, ethical and cultural references. However, the scarce studies undertaken unveil that history of science is not mentioned in science classes, or it only relies on internalist positions (Duarte, 2003). We consider that the incorporation of history of science in science classes may prompt a better understanding of knowledge production and reconstruction. Also, it may contribute to better prepare students to become scientific literate citizens and to be able of taking decisions about social problems, according to their personal understanding regarding scientific and technological processes of our world (Silva and Rodrigues, 2012). In this way, we believe that teachers in general and science teachers in particular should have a strong background concerning history of science. It is not worthwhile to change curricula if no differences were found between the teachers that implement it. In Portugal, there are few universities that include History of Science or History and Philosophy of Science subjects in Pre-service teachers training. In a study conducted by us, only Trás-os-Montes e Alto Douro University (UTAD) and Nova de Lisboa University possess

these subjects in their syllabus. We realized that prospective teachers, that take part of this research, improved their scientific and cultural knowledge and, as a consequence, they are better prepared to prompt an enriched teaching to their students.

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Appendix 1_ Questionnaire

This questionnaire is anonymous and is intended to collect data for a study on the Scientific Culture of University students. Thank you very much for your cooperation.

Gender: Male _____Female _____↑

1 - How do you score your interest in scientific culture?

Very None Some interest Yes No .

2 – Do you usually watch or listen to scientific programs on the radio or on TV?

Yes No . If yes, state which (s)? _____

3 – Do you usually read articles / books or magazines related to science?

Yes No . If yes, state which (s)? _____

4 - In the last year did you visit science museums or participate in events with scientific interest?

Yes No . If yes, state which (s)? _____

5 - Provide the name of at least one institution that makes science dissemination.

_____.

6 - Do you know a Portuguese scientist of repute who is still carrying on its activities in Portugal or abroad?

Yes No . If yes, state which (s)? _____

7 - Match each discovery with its author:

Charles Darwin _____	1) Atom
Gregor Mendell _____	2) Theory of Relativity
Isaac Newton _____	3) DNA
Alexander Fleming _____	4) Theory of Evolution
Alfred Wegener _____	5) Heredity
Pedro Nunes _____	6) Plate tectonics
Rutherford e Niels Bohr _____	7) Heliocentric
Thomas Edison _____	8) Nobel Prize for Medicine (Portuguese)
António Damásio _____	9) Telescope
Watson e Crick _____	10) Penicillin
Copérnico _____	11) A pioneer in Botany
Garcia da Horta _____	12) Development of Navigation
Egas Moniz _____	13) Lamp
Edwin Hubble _____	14) Pioneer in Sexology
Albert Einstein _____	15) severity of Laws
Amato Lusitano _____	16) Microscope
William Harvey _____	17) Blood circulation
Leewenhoek _____	18) Neuroscience

8 – How do you evaluate your knowlege in Science?

Very good Good Satisfactory Weak Very Weak Do not know No Answer

9 – Do you consider important that a citizen has scientific culture?

Yes No . Yes No