

Debates on gravitation theories in a pre-service physics teaching course: some challenges and possibilities

Flávia, POLATI

*PhD Candidate, Graduate Program in Science Education, Institute of Physics,
University of Sao Paulo, Brazil*

Valéria, DIAS, João, ZANETIC

Institute of Physics, University of Sao Paulo, Brazil

Abstract. In this paper we present the results of a research in a pre-service teacher training course named Gravitation, regularly offered in the first year of the a pre-service physics teacher program at the University of Sao Paulo, Brazil. We find in this research that different teaching strategies using historical episodes and philosophical debates can contribute to more pluralistic and critical teacher training, capable of demystifying misconceptions about how scientific knowledge is constructed throughout history.

Keywords: Pre-service physics teachers, history and philosophy of science, gravitation theories.

1 Introduction

The History and Philosophy of science concepts in school science curriculum and official documents have been highlighted in many countries, like in the US *American Association for the Advancement of Science 2061 Project*, or the *British National Curriculum in Science* in the UK. One of the projects developed in 1960's, the *Harvard Project Physics Course*, has been one of the most popular school science curriculum for introducing history, philosophy and cultural elements of physics [1].

Most recently in Brazil, the National Curricular Parameters (PCNs) for secondary education had a direct influence on the teaching of science concepts inside the classrooms. Also, PCNs drove the *National Program of Textbooks for Secondary Education* in the quality of contents on history and philosophy of science in recent collections. However, some physics textbooks still presents popular myths, and many of them presents historical distortions, such as *Anachronism*, *Linear history*, *Romantic story* and misconceptions about Nature of Science (NOS), or make reference to the universal scientific method [2], [3].

By the understanding of science teaching as a complex educational process, we defend that it cannot be disconnect from the interpretive assumptions and values of teachers on scientific knowledge. Since there are multiple parameters and interests on education around different countries, and we live in a plural world that is not limited to a single model of science or teaching, it's necessary to prepare teachers to deal with the plurality of scientific knowledge and practices of contemporary teaching strategies.

Gravitation are an important part of Classical Mechanics that was built on a variety of theories born different locations and times, presenting such plurality. On the other hand, the majority of the classical mechanics courses, introduce this concepts using only the most famous personalities and facts, but less famous scientists and philosophers are overshadowed [4].

In this perspective, is important to prepare teachers in a intellectual and critical view about the physics knowledge, who participates actively in his learning process, seeking to discover the hidden, revealing the historical and social origins of what he learns in a natural way [5],[6]. Using the history of science, rescuing the memory of ideas inspiring facts and phenomena, and philosophy narrating epistemological evolution, has a prominent place in the perspective of the training of science teachers as intellectuals and with a critical worldview.

2 History and Philosophy of Gravitation Theories in a Physics Training Course

This paper is part of a PhD research that has the goal to investigate how to promote debates involved about historians and philosophy of science episodes on the gravitation theories in a pre-service physics teacher course.

Thus, we present in this paper some challenges and possibilities tried in the course named *Gravitation*, regularly offered in the first year of the a pre-service physics teacher program at the University of Sao Paulo, Brazil. This course seeks to introduce concepts of physics through the historical and philosophical development of the gravitation theories, starting with the Greeks, going to contemporary theories of gravitation, such as the General Relativity Theory.

We used different didactic strategies such reading original manuscripts by groups of pre-service teachers, computer simulations, debates, drawings and schematic representations and preparation of written essays. In this paper, we have presented in Table 1 (Fig.1) only three activities to show some historical episodes selected, the didactic strategy and the conceptual and formative objectives.

Historical Episode	Didactic Strategies
Plato and Aristotle's System of the world	To read original manuscripts (<i>On the Heavens</i> and <i>Timeo</i>). To discuss in small groups. To present the discussion to all students
Johannes Kepler and the laws of planetary motion	To draw the orbits of planets in scale (first law). To represent the variation of equal areas in equal times (second law).
Albert Einstein, Arthur S. Eddington and the new gravitation theory	To demonstrate computer simulations To read a Historical Inquiry Case. To ask some inquiry questions

Fig. 1 Activities selected to exemplify the historical episode, the didactic strategies and conceptual goals

Conclusion

In this paper, we would like to show how the historical and philosophical perspective contribute to pre-service physics teachers understand the processes of building science through a critical and intellectual judgment on the NOS aspects. In the full presentation, we will show that most pre-service teachers emphasized differences knowledges NOS aspectos, such as the science is tentative, the influences of social aspects, among others, that contribute to a worldview of scientific knowledge more plural and complex.

References

- [1] Matthews, M. (1992). History, philosophy, and science teaching: the present rapprochement. *Science & Education*, 1, 11-47.
- [2] Allchin, D. (2003a). Scientific myth-conceptions. *Science Education*, 87, 329-351.
- [3] Whitaker, M. A. B. (1979a). History and quasi-history in physics education – Part 1. *Physics Education*, 14 (2), 108-112.
- [4] Gauld, C. (2014) Using history to teach mechanics. In: M. R. Matthews (Ed.), *International handbook of research in history, philosophy and science teaching* (pp. 57-95). Springer: Dordrecht, Heidelberg, New York, London.
- [5] Giroux, Henry A. (1988) *Teachers as intellectuals: toward a critical pedagogy of learning*. Bergin & Garvey Publishers, Inc..
- [6] FREIRE, Paulo. (1996) *Pedagogia da autonomia: saberes necessários à prática educativa*. São Paulo: Paz e Terra.