

ATOMIC MODELS: AN ANALYSIS IN ENGLISH AND PORTUGUESE SEARCH

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1. INTRODUCTION

Intending to explain the structure of matter, many representational models about the atomic structure were developed. In science we should not assume only one explanation, hence, there are several atomic models accepted and used. The models have not an excluding order between them, so, many times we can evoke different atomic models to explain chemistry concepts. According to MELZER; AIRES (2015) and MOURA; GUERRA (2016) many works were done and a lot of scientists and philosophers were involved in the search for an explanation to atomic structure, with several areas of knowledge.

In an attempt to identify the atomic models presented in the conceptual discussion recently, we aim to analyze the results from a Literature Review in some databases in the last ten years of publications in Portuguese and English language about the atomic models. We intend to compare the atomic models found in the Portuguese and English language seeking for similarities and differences between them.

2. METHODOLOGY

This work consists of qualitative research, from a literature review based on the documental analysis by Mattar and Ramos (2021). This work aims to observe and compare the atomic models who were figured out in articles that propose the conceptual discussion of the structure of matter and atomic models.

The literature review was made in the databases Periodicals Gate CAPES¹ and Scientific Electronic Library Online (SciELO) with the five terms: atom, atomic model, atomic structure, atomistic and structure of matter in English. In Portuguese the search terms were: átomo, modelo atômico, estrutura atômica, atomística and estrutura da matéria. The filter peer-reviewed was used and the article language was Portuguese and English, respectively.

The inclusion criteria to select the articles to do the complete reading and analysis was the period from the year 2012 to 2023 and the papers which the authors sought to discuss conceptually the atomic models and the structure of matter, excluding any work that applied the concept. We consider an application the use of the atomic structure to explain any technique or analysis device, synthesis or optimization of molecules and compounds, or else, another concept

¹ This is an acronym for for Coordination for the Improvement of Higher Education Personnel, Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, in Portuguese.

like math or physics. These criteria were used in the Portuguese and English research.

We have done the search with the key words in Portuguese and in English intending to amplify the results and look if there are differences in the atomic models found and the discussion made by the authors in articles.

The second step, after the examination in the databases with the search terms, was to read the title of the articles to choose which had fitted in the inclusion and exclusion criteria, then the third was to read the abstract and in the final, to do the complete read of the articles to select which will be analyzed. After this, the selected articles were read, and the atomic models identified.

3. RESULTS AND DISCUSSION

The search found, at least, ten articles in Portuguese and three in English, after the complete read. The article title, journal, year of publication and atomic models are in Table 1.

Table 1. Atomic models found in the research in Portuguese and English.

Article title	Journal	Atomic Models
A representação de Kraus para a dinâmica de sistemas quânticos abertos	Revista Brasileira de Ensino de Física	átomo quântico (Heisenberg;Schrodinger)
As Intuições Atomísticas de Bachelard	Revista Brasileira de Pesquisa em Educação em Ciências	Dalton, Thomson, Demócrito, Lucrécio, Gassendi, Huygens; Boyle
Niels Bohr, espectroscopia e alguns modelos atômicos no começo do século XX: um episódio histórico para a formação de professores	Caderno Brasileiro de Ensino de Física	Dalton, Thomson, Nagaoka, Rutherford, Nicholson, Bohr, Sommerfeld
O centenário da Teoria de Bohr	Química Nova	Bohr, Thomson, Rutherford, Lewis
O modelo atômico de Bohr e as suas limitações na interpretação do espectro do átomo de hélio	Caderno Brasileiro de Ensino de Física	Dalton, Thomson, Nagaoka, Rutherford, Bohr
Os 100 anos do átomo de Bohr	Revista Brasileira de Ensino de Física	Rutherford, Thomson, Nagaoka, Quântico, Sommerfeld
Os cem anos do átomo de Sommerfeld	Revista Brasileira de Ensino de Física	Sommerfeld, Bohr
Os químicos ocultos e sua extraordinária jornada ao mundo dos átomos	Química Nova	Charleton, Boscovich, Prout, Dalton, Lorde Kelvin, Annie Besant, Thomson, Rutherford, Crookes
Revisiting Angular Momentum Quantization in Bohr's Atomic Model	The Journal of Engineering and Exact Sciences	Bohr, Dalton, Weber, Fechner, Lorentz, Thomson, Lord Kelvin, Nagaoka, Perrin, Rutherford, Nicholson, Bohr, Bohr-Ishiwara-Wilson-Sommerfeld

The Pre-Service Science Teachers' Mental Models for Concept of Atoms and Learning Difficulties	International Journal of Education in Mathematics, Science and Technology	Demócrito, Leucipo, Dalton, Lavoisier, Thomson, Rutherford, Bohr, Quântico
Trechos de Bohr sobre modelos atômicos: indícios sobre como a física é construída e possibilidades enquanto recurso didático	Alexandria (Florianópolis)	Bohr, Rutherford, Thomson, Nicholson
Um olhar para o conceito de átomo: contribuições da epistemologia de Bachelard	Alexandria (Florianópolis)	Thomson, Rutherford, Bohr, átomo quântico
Understanding Atomic Structure: Is There a More Direct and Compelling Connection between Atomic Line Spectra and the Quantization of an Atom's Energy?	Journal of Chemical Education	Bohr, Rutherford

The results were found in English and Portuguese at different moments and the atomic models were identified in two sections, so we can compare them. In the Portuguese search we observed 18 atomic models, and in English 18 too. Even though there are fewer articles, more models to explain the structure of matter are discussed in English. We consider in this work atomic models investigated using the scientific method, as well the philosophical explanations to the matter constitution. The atomic models found separated by language are in Table 2 and the general characteristics about them will be discussed in the following.

Table 2. Atomic models found in the research in Portuguese and English.

Language	Models of explanation of structure of matter
Portuguese	Annie Besant; Niels Bohr; Boscovich; Boyle; Charleton; Dalton; Demócrito; Pierre Gassendi; Huygens; Lewis; Lord Kelvin; Lucrécio; Nagaoka; Nicholson; Quântico; Rutherford; Sommerfeld; Thomson.
English	Bohr, Bohr-Ishiwara-Wilson-Sommerfeld, Dalton, Democritus, Fechner, Lavoisier, Leucippus, Lord Kelvin, Lorentz, Nagaoka, Nicholson, Perrin, Quantic, Rutherford, Thomson, Weber.

We list philosophical explanations as: Annie Besant, Boscovich, Charleton, Democritus, Pierre Gassendi, Leucippus, Lucretius (Lucrécio). The scientific based models are: Bohr, Bohr-Ishiwara-Wilson-Sommerfeld, Boyle, Dalton, Lavoisier, Lewis, Lord Kelvin, Lorentz, Nagaoka, Nicholson, Perrin, Quantic, Rutherford, Sommerfeld, Thomson, Weber.

There are sixteen scientific models found in the articles, twelve in Portuguese and fifteen in English. And the philosophical seven, all of them are in Portuguese and in English Democritus and Leucippus.

We can observe that the philosophical models are more covered in Portuguese, the two of them in English are discussed in Portuguese too. Already the models based on the scientific method have more space in English than in Portuguese, we can verify Bohr-Ishiwara-Wilson-Sommerfeld, Fechner, Lavoisier, Lorentz, Perrin and Weber discussed only in the English articles and Boyle, Huygens, Lewis and Sommerfeld only in Portuguese.

4. CONCLUSIONS

We can perceive that there are differences in the atomic models discussed in Portuguese language and English. In this case, to use the search terms in the different languages contributes to amplifying the results.

We can classify the explanations to the structure of matter in two main groups: The philosophical based and the scientific method based. Besides that, there are more scientific models to the atomic structure and we can observe that there are the same number in Portuguese and English. But in Portuguese we have more Philosophical discussion and in English more Scientific discussion.

5. BIBLIOGRAPHIC REFEREES

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