The flat earth model – mapping misconceptions and failures

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Abstract. This research tries to map the failures and misunderstandings that lead to the perception of the earth as flat, and sort them into two types: the lack of scientific knowledge, and misconceptions about the nature of science. From this it is possible to propose educational emphases that can deal with these perceptions.

Introduction

In recent years, there has been active activity by flat earth believers on social media, as part of a lack of trust in science [1]. Although it is in fact a pseudo-science, so it is difficult to apply principles of academic freedom to it [2], it enjoys some success, which is reflected among other things in social networks and in places where there is no appropriate scientific criticism.

The claims and reasons put forward by those who believe in flat earth model (FEM) belong to very different types. Some of them are social or religious, and this study does not deal with them. This study deals with arguments of a scientific or pseudo-scientific nature, that is, arguments that try to scientifically prove that the sphere model is illogical, and the correct model is FEM.

The research tries to map the claims according to the failures or misconceptions behind them. Such perceptions can be based on a lack of scientific knowledge, such as the argument that a rapidly rotating body causes what it must detach from, without realizing that the significant quantity here is not the tangential velocity but the acceleration, which is very small compared to the acceleration of gravity (a ratio of approximately 1:100). On the other hand, such perceptions can arise in the absence of a correct understanding of the nature of science (NOS) [3], for example the lack of understanding of the need for a coherent theory, which includes many details that complement each other, or a lack of understanding of the scientific procedure and practices [4].

From this arise the research questions:

- What are the main arguments (scientific or pseudo-scientific) used by those who believe in FEM?
- What fallacy or misconception are these arguments based on?
- What educational approach can deal with this?

Method

The research population is the people who believe in the FEM. The sample is taken from people who are active on the Facebook social network. In order to get a variety of arguments, 25 posts were selected, of which 10 were verbal posts, 5 videos (some of them linked to the YouTube social network), and 10 pictures with short text (memes). This sample was chosen to obtain a variety of arguments for qualitative analysis, but it is not enough to perform a quantitative analysis. The arguments were taken from things people wrote, said or commented. The reference is to the body of an argument, and not to the body of a claimant, that is, we will not examine whether the claimant actually believes the things or is a "troll" who came to mock these arguments.

The arguments were thematically analyzed and mapped according to their basis of error. They were sorted according to the error on which they are based, distinguishing between a scientific error and NOS ones. However, the sample should not be quantitatively representative, so the percentage of errors of each type is irrelevant.

Findings

The arguments brought by the people who believe in FEM are arguments of different kinds. First, they include pseudo-scientific content arguments, that is, arguments that sound like scientific arguments, but there is one fallacy behind them. In addition, there are social arguments, such as those describing the governments' desire to control the people through false scientific theories. Because of this, many arguments come in combination with a lack of trust in the political establishment, and a lack of trust in the scientific establishment, such as opposition to vaccines, and denial of the COVID-19 epidemic. Such social arguments are not the concern of this study.

In addition, many of the arguments come in the approach of mocking the scientific model of the earth, gravity and more. The analysis of the arguments reveals that they are based on a lack of knowledge of scientific principles, such as the distinction between speed and acceleration, the meaning of gravity, and understanding the directions "up" and "down" on the surface of a sphere. This shows a lack of understanding of the difference between a sphere on the earth, in which the force of gravity is downwards - towards the earth, and a sphere (like the earth or any planet or star), in which the force of gravity is towards the center of the sphere.

Beyond that, various arguments show a lack of understanding of the scientific process and NOS. For example, there is an attitude that tries to rely solely on what the eyes of the observer see, while ignoring NOS as an array of knowledge accumulated over hundreds of years.

Conclusion

This preliminary study attempts to map the misunderstandings at the base of the perceptions of the believers in FEM. Beyond social perceptions that are not the concern of this study, and beyond the attitudes of snickering, emerge characteristics of the lack of basic scientific knowledge, and the lack of well-founded perceptions about NOS. The perceptions about NOS can be categorized [5] according to different approaches [e.g. 6,7].

These results pose a challenge to educators and curriculum designers [8], so that the graduates of the education systems will receive a more extensive education, both in the scientific content and in NOS, thus training a generation of students with more correct concepts, something that will reduce, even if not prevent, wrong concepts.

References

[1] R. Darner, How can educators confront science denial?. *Educational Researcher* **48**(4) (2019) 229-238.

[2] R. Boden and D. Epstein, (2011). A flat earth society? Imagining academic freedom. *The Sociological Review* **59**(3) (2011) 476-495.

[3] C. Mattos et. al., The Public Discussion on Flat Earth Movement: An Analysis Based on the Esperantist-Epideictic Discourse. *Science & Education* **31**(5) (2022) 1339-1361.

[4] A. J. Sharon and A. Baram-Tsabari, Can science literacy help individuals identify misinformation in everyday life?. *Science Education* **104**(5) 2020 873-894.

[5] E. Y. Weissman, A. Merzel, N. Katz, I. Galili, Teaching quantum physics as a structured physics theory in high school. In *Journal of Physics: Conference Series* **1929**(1) (2021) 012051.

[6] N. G. Lederman, F. Abd-El-Khalick, R. Schwartz, *Encyclopedia of science education*, ed R. Gunstone (Dordrecht: Springer) pp. 704–8, 2015.

[7] I. Galili, Towards a refined depiction of nature of science: applications to physics education. *Science & Education* **28**(3-5) (2019) 503-537.

[8] S. Barzilai, C. A. Chinn, A review of educational responses to the “post-truth” condition: Four lenses on “post-truth” problems, *Educational Psychologist* **55**(3) (2020) 107-119.