



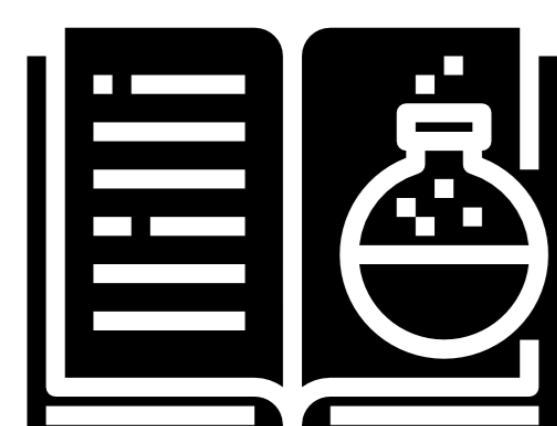
## History of Science in promoting argumentation for future chemistry teachers

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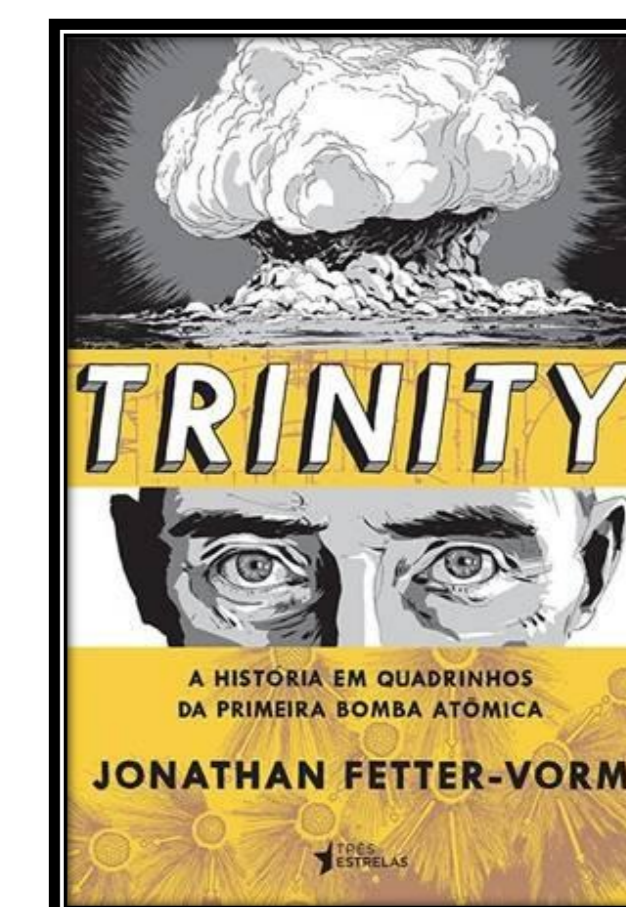
Considered as a recurrent practice in constructing scientific knowledge, argumentation has been increasingly encouraged in science teaching settings [1].

Among the strategies encouraging argumentation, the approach to socio-scientific issues (SSI) is of particular interest, as, according to its characteristics, it does not only contribute to peoples' education who understand the nature of science, its applications and social implications, economic and political aspects of scientific knowledge, but also helps their moral development [2].



A retrospective view of the development of the science allow us to identify different SSI that can be treated in science education, as the building of nuclear weapons.

The present study addresses using a didactic sequence that encourages argumentation on SSI related to a historical episode



While narrating the events that led to building the atomic bombs that were dropped on the Japanese cities of Hiroshima and Nagasaki, the author of the graphic novel mainly uses a historical approach. Meanwhile, some of the main discoveries and scientific concepts related to the theme are presented to the reader, such as: the Curies' observation of radioactivity; atomic models explaining the behavior of matter; and the nuclear fission process.



Reading the graphic novel.

Written activities related to the graphic novel.

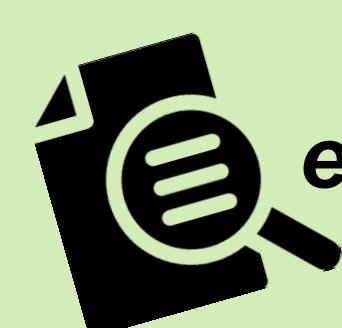


This study was taken in a discipline aimed at the initial training of chemistry teachers in a Brazilian public university. The didactic sequence was used in eight classes of 100 minutes each, and included four types of activities:

### Historical case studies and its application.

The cases for argumentation were developed based on the material *Moral Reasoning in Scientific Research* [4] and consists in three situations involving dilemmas experienced by the characters who needs to make a decision about different issues.

As an example, in front of the secrecy demanded by the Manhattan Project, in the first case Oppenheimer confronts a dilemma related to give, or not, certain freedom to the scientists who claims that the development of the Science depends of the pairs communication.



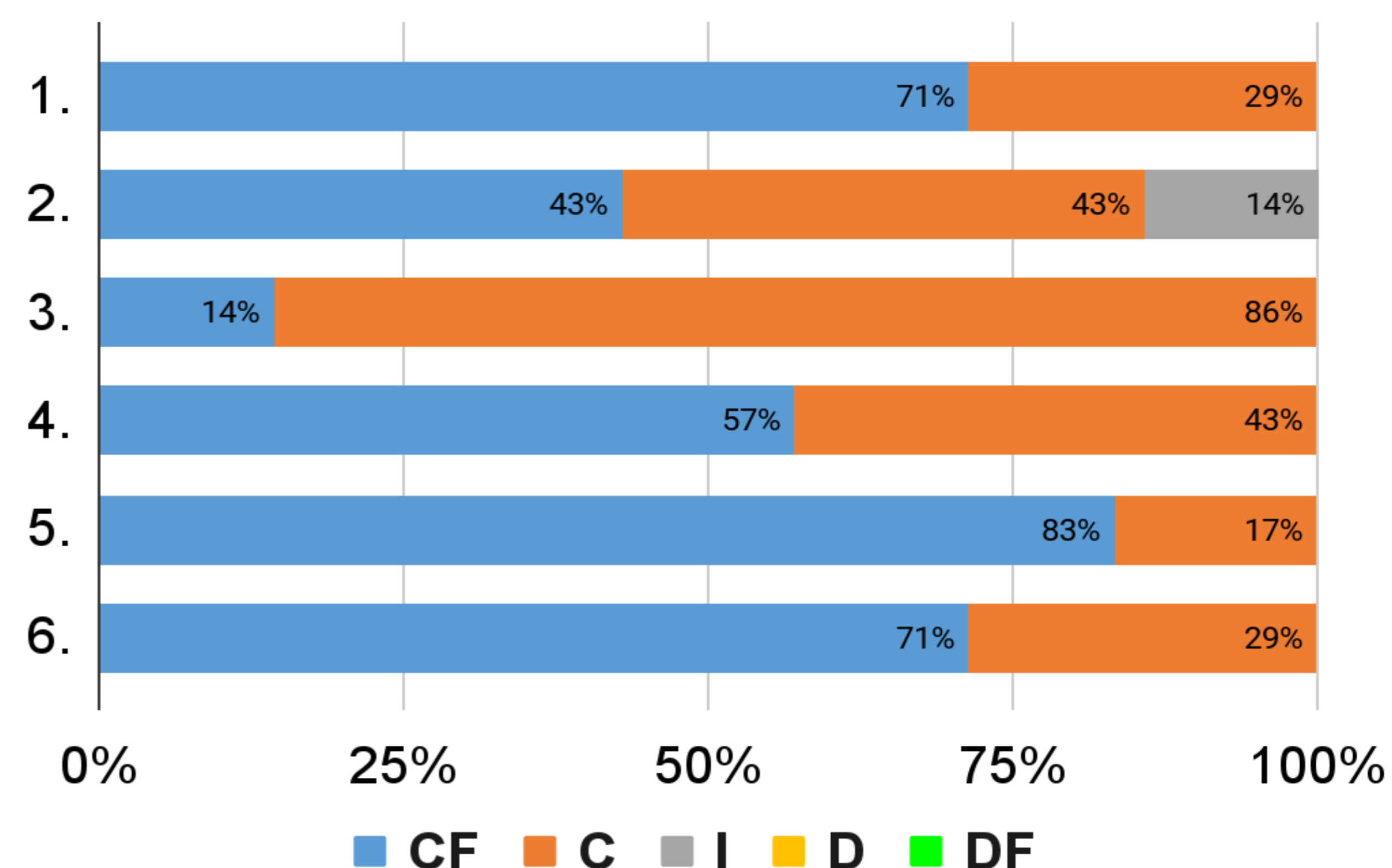
Historical case studies extracted from the novel.

Feedback of the arguments.



A	B	C	D

1. The activities related to the graphic novel allowed me to develop my ability of written argumentation.
2. The oral discussions about each one of the cases extracted from the graphic novel contributed for an improvement of my written arguments.
3. The activities related to the graphic novel allowed me to develop my ability to make a decision in facing problems that involve ethical and moral dimensions.
4. The activities related to the graphic novel allowed to develop my ability of critical analysis in facing problems concerning to the chemical impacts in the society.
5. I liked to work with the graphic novel "Trinity: the graphic history of the first atomic bomb"
6. I would like to participate more times in activities involving the argumentation and decision making on socio-scientific issues (SSI).



Analyzing these perceptions showed that didactic sequence was effective in promoting future teachers' arguments about historical scientific episodes. Furthermore, the theme favors the understanding of constructing science and provides an argumentative practice contextualized with the historical moment addressed, which implies an understanding of the political, ethical, moral, economic and social impacts of scientific practices. Such aspects are relevant and necessary for teacher education, as knowledge of different methodological tools, such as graphic novels, as well as an understanding of the importance of argumentation in science can lead to future teachers implementing it.

- [1] Bag H, Çalik M. A thematic review of argumentation studies at the K-8 level. *Education and Science*, 2017, 1-23.
- [2] Sadler TD. Informal reasoning regarding socioscientific issues: a critical review research. *Journal of Research in Science Teaching*, 2004, 41, 5, 513-536.
- [3] Fetter-Vorm, J. *Trinity: a graphic history of the first atomic bomb*. New York: Hill and Wang, 2012.
- [4] BEBEAU, M. J. *Moral Reasoning in Scientific Research*. University of Minesota, 1995. 83p.