Effects of a Historical Story on Student Understanding of NOS

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Abstract
Science educators have identified that Nature of Science (NOS) is essential to improve students’ science literacy. Numerous empirical studies suggest that incorporating the history of science (HOS) into class by means of an explicit reflective approach is one way to promote students’ NOS conceptions. In view of these findings, we developed a unit using an interrupted story technique to depict the discovery of the structure of DNA featuring Rosalind Franklin’s neglected role to help students learn both science content and NOS. Our study design compares an experimental group (story used) with a control group (no story used). The SUSSI (a well known instrument to study NOS) was administered pre- and post-instruction during both terms to assess the impact of this lesson on students understanding of the NOS. Semi-structured interviews were conducted to further clarify students’ responses. The results show that most of the participants in the experimental group made significant gains in their understanding of two aspects of NOS targeted by the NOS. The SUSSI was administered pre- and post-instruction with a control group (no story used). The SUSSI (Student Understanding of Science and Scientific Inquiry) instrument was used to assess the impact of the lesson on students’ NOS views (Liang et al. 2008).

Data Collection and Analysis

Part One of the historical narrative, sharing the discovery of the structure of DNA as it is typically portrayed as the result of Watson and Crick’s work, promotes students’ understanding of the role of creativity and imagination in science. Pre-assessment: “Most often scientists do not use their imagination/creativity in science. This is because science is a logical field.” – Student 6
Post-assessment: “The process of science involves creativity and imagination because creativity inspires questions and experiments. A person has to be creative in order to come with a way to experiment their hypothesis.” – Student 6

Research Design

Nature of Science (NOS)
• BIOS 1120 for non-major college students
• 212 participants from a flipped introductory biology course
• Same instructors for both semesters
• Fall 2017 – Control group
• Learned about the discovery of the structure of DNA in the absence of the story
• n=124; 13 interviews
• Spring 2018 – Experimental group
• Learned about the discovery of structure of the DNA using the interrupted story
• n=88; 14 interviews; 7 females & 7 males

History of Science (HOS)
• Teaching science with the history demystifies the process of science and provides students contextualize settings for learning NOS concepts.
• HOS has been rarely used by science teachers because of the lack of HOS knowledge and integrated approaches.

Research Background

Nature of Science (NOS)
• NOS is referred to a host of general issues associated with the process of science.
• NOS is essential to improve students’ science literacy (AAAS, 2009).
• Students and teachers have difficulty understanding issues associated with NOS.

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In the experimental group, all female interviewees believed that women scientists today still do not have equal rights. They related the Rosalind Franklin’s example to their own family issues, work experiences, and male-only stereotype in society. In sharp contrast, three of 7 male interviewees indicated they believed the gender issue has declined dramatically since the 1950s, that men and women scientists nowadays are generally treated as equals.

Conclusions
1. Students in the experimental group made significant changes between pre- and post-assessment in their understanding of two aspects of NOS including creativity and imagination, and social and cultural influences on science, in scientific investigations.
2. Most interviewees in the control group specifically mentioned that the historical story associated with discovering the structure of DNA helped them make changes in understanding the two aspects of NOS.
3. There is a significant difference between the opinions from male and female participants in the experimental group about whether gender inequality still persists in the modern world.

Implications
1. This research addresses a gap about the effectiveness of historical narratives for improving students’ NOS views.
2. It provides insights on how to incorporate HOS into science class explicitly and reflectively.
3. It also gives science teachers effective instructional materials to teach NOS using a narrative based on the history of science.

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