

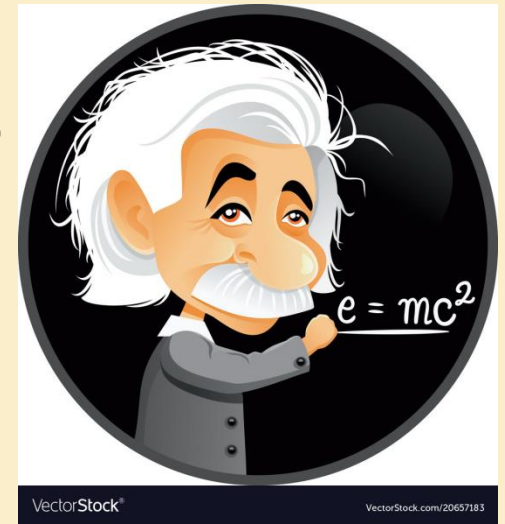
THE NATURE OF SCIENCE (NOS)

BY

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What is science?

- the careful study of the structure and behaviour of the physical world, especially by **watching, measuring, and doing experiments**, and the development of **theories** to describe the results of these activities
(<https://dictionary.cambridge.org/dictionary/english/science>)
- the careful study of the structure and behaviour of the world, especially by **doing experiments**
- a subject that is studied using **scientific methods**:



What then is the Nature of Science?

- NOS refers to the epistemology and sociology of science, science as a way of knowing and understanding the natural world, and the role of values and beliefs of the scientific community in the development of scientific knowledge (Lederman, 1992; Lederman & Lederman, 2004).
- a “hybrid arena which blends aspects of various social studies of science including the history, sociology and philosophy of science combined with research from the cognitive sciences such as psychology into a rich description of which science is, how it works, how scientists operate as a social group and how society itself both directs and reacts to scientific endeavors” McComas, Clough, and Almazroa

More definitions of NOS?



- a combination of at least ten aspects known as the tenets of NOS. The aspects are: Empirical; Inferential; Creative; Theory-driven; Tentative; Myth of The Scientific Method; Scientific theories; Scientific laws; Social dimensions of science; and Social and cultural embeddedness of science (Lederman, 2007).
- The aims and values, methods, practices, knowledge, social certification and dissemination, social ethos, social values, professional activities, social organisations and interactions, financial systems and political power structures

This concoction of definitions of what the NOS is has caused confusion and a naïve understanding of what NOS is...

Teacher`s understanding of the nature of science

- regardless of the level of education, there is an **inadequate understanding** of the NOS internationally Akerson et al. (2000)
- South Africa is no exception to these findings Bantwini et al. (2003) the NOS is one that is **naively understood** by teachers (Gwebu, 2015)
- an overall inadequate understanding of NOS(Govender & Zulu, 2017) However, some teachers held **adequate** understanding in the tentative NOS and the subjectivity and objectivity of science

Why learn about the nature of science?

1. To develop the **pedagogical content knowledge** of the teacher in teaching science (Chaiyabang & Thathong, 2014)
2. To distinguish between **science and non-scientific** disciplines and how science differs from other ways of thinking (Bell, 2008)
3. To identify the **strengths and limitations** of scientific knowledge (Vhurumuku, 2010)
4. To increase **scientific literacy** (Chaiyabang & Thathong, 2014)
5. To increase **learner interest** in science through scientific investigations (Vhurumuku, 2010)

Why learn about the nature of science?

Because CAPS says so...

CAPS for Physical Sciences (grades 10-12) explicitly states in its Specific Aim number 3 that Physical Sciences should ensure “an understanding of the nature of science and its relationships to technology, society and environment”

In the LS curriculum statements it is stated that through the studying of science, learners will develop scientific skills “and ways of thinking scientifically that enable them to see the flaws in pseudo-science in popular media” (Department of Basic Education, 2011c, p. 8).

Why learn about NOS?

Increases learner interest in science



- Learners will learn about the different science fields and the methods that can be used in each (there isn't one scientific method)
- Give the learners hands on experience of scientific methods and practices eg through science expos

Why learn about NOS?

Through research and projects learners will learn

- Aims in science such as accuracy
- To provide empirical evidence before making a claim
- Scientific work is subject to review
- To consider the ethical values of science
Financial considerations
- Implications of their findings on decision making in their personal lives and as global citizens

Why learn about NOS?



dailymail.co.uk

- an understanding of the nature of science develops **scientific literacy** (Pavez et. al, 2016) and assists individuals in **personal decision making** in everyday life.
- Learner examples
- to **distinguish between science, religion** and other forms of knowledge such as **pseudoscience** (Bell, 2008).

Decision making...Personal experiences

Dieting and health related issues...



<https://www.youtube.com/watch?v=Jf44vLndiRM> what the health

<https://blog.daveasprey.com/what-to-tell-your-friends-about-the-claims-from-what-the-health/>

WHY RESPOND TO SOMETHING SO ... NOT SCIENCE?

Normally, something like this doesn't even deserve a response, but some of the claims in this movie are downright harmful.

When controversial documentaries, articles, and conversations cross into your personal space, remember one thing:

If you present solid science, you don't have to emotionally charge your audience with scenes of parents serving their children cigars wrapped in hot dog buns. Heavy-duty evidence stands on its own.

After watching *What the Health*, your friends start side-eyeing the hunk of butter you just plunked into your coffee. If you're looking for some real science behind the claims in this movie, read on.

HERE ARE THE TOP 10 CLAIMS FROM *WHAT THE HEALTH* AND THE REAL SCIENCE BEHIND THEM.

Why learn about NOS?

To produce global citizens who can contribute to socio-scientific arguments...



Climate change...



- What are you doing to slow down climate change?

Decision making

What are you doing in your personal capacity to stop climate change?



Is there enough information out there?



My contribution to slowing down climate change

According to davidsuzuki.org

- Demand climate solutions this election
- Use energy wisely and save money too
- Charge up with renewables
- Eat for a climate-stable planet
- Start a climate conversation...

The Nature of Science in science textbooks

- Heavy reliance on textbooks by teachers and pupils
- Textbooks are CAPS compliant and so should reflect the NOS as CAPS does
- Textbook analysis has been carried out for the last 4 decades on high school chemistry textbooks in the USA for a representation of NOS

An analysis of Grade 9 CAPS compliant NS textbooks for a representation of NOS

- Used a framework by Abd-El-Khalick based on the following tenets of NOS
- Empirical; Inferential; Creative; Theory-driven; Tentative; Myth of The Scientific Method; Scientific theories; Scientific laws; Social dimensions of science; and Social and cultural embeddedness of science.

Findings

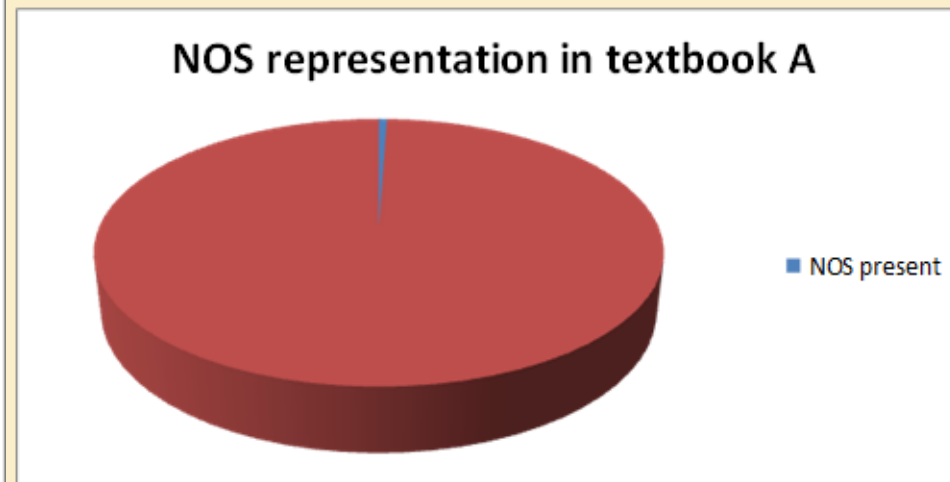
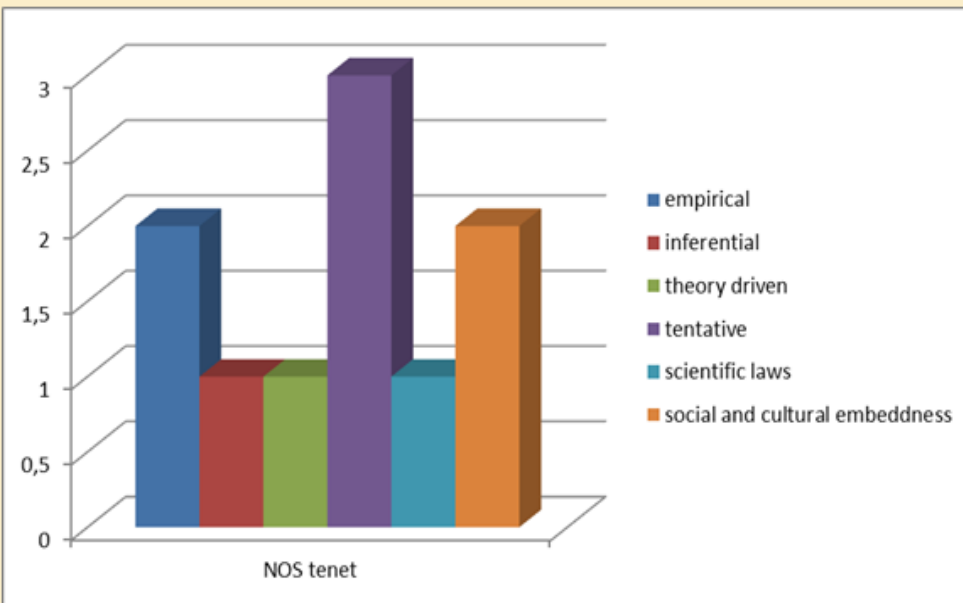
NOS tenet	Textbook A	Textbook B	Textbook C
Empirical	2	3	3
Inferential	1	2	0
Creative	0	0	4
Theory-driven	1	0	1
Tentative	3	2	11
Myth of “The Scientific Method”	0	0	0
Scientific theories	0	0	0
Scientific laws	1	0	4
Social dimensions of science	0	3	1
Social and cultural embeddedness of science	2	3	2
Science vs pseudoscience	0	0	0
Total occurrences of NOS tenets	10	13	26

Findings...

- Very little or no representation of the NOS in the 3 CAPS approved textbooks analysed
- Padayachee (2012) revealed that there was inadequate representation of NOS in Biology and Life sciences textbooks
- (Campanile, Lederman, & Kampourakis, 2015) conducted a research in which the analysis of biology textbooks in the USA for NOS and SI representation provided recommendations on how an analysis of this nature can be used for TPDP on NOS.

NOS in Textbook A

NOS Occurrences



Distribution of the NOS among the four natural sciences strands



Recommendations...

- There is a need to train teachers to improve their understanding of NOS through professional development courses
- Govender & Zulu (2017) proposed that the naïve understanding of NOS displayed by the participants in their study can be attributed to a lack of formally acquired NOS knowledge by the teachers.
- Allowing teachers to partake in the analysis of textbooks for NOS, they would come to realise the instances and opportunities that they can use in the classroom for teaching with and about NOS.

Answers?



Thank you for your attention
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