

Does Teaching Teachers About the Nature of Science Matter?

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The Nature of Science in the Irish Primary Classroom

⌘ Phase 1: Pre-service teachers

- ☑ Developing conceptual and pedagogical knowledge of NoS

⌘ Phase 2: Beginning teachers

- ☑ **Beginning primary teachers:** experiences of teaching NoS
- ☑ **Primary pupils:** effects on experiences of and attitudes towards school science

Concerns in Ireland



⌘ Teaching of Primary Science

- ⊗ INTO Survey (1987)

- ⊗ NCCA Primary Curriculum Review (1990)

⌘ Learning in Primary Science

- ⊗ IAEP (1992)

- ⊗ TIMSS (1997)

⌘ Uptake of science

Number of Initiatives



⌘ Task Force for the Physical Sciences *(2000)*

⌘ Revised Science Curricula

⊗ Concepts, skill development & scientifically
informed citizen

However ...

⌘ **Still lack of uptake of science** (*OECD, 2002*)

⌘ **Concerns regarding children's learning in primary science** (*NCCA Curriculum Review, 2008*)

☒ Irregularity of hands-on science

☒ Concern over breadth and complexity of science skills employed

☒ Environmental awareness and care strand infrequent

(*Varley, Murphy & Veale, 2008*)

Broad Aims of Phase 2



To explore:

- the extent to which beginning teachers explicitly plan for and teach about NoS
- the effects of explicitly teaching NoS on primary children's NoS conceptions and their experiences of school science

Contemporary NoS Conceptions



⌘ BoK

☒ *Reliable, tentative and developmental*

⌘ Scientific Inquiry

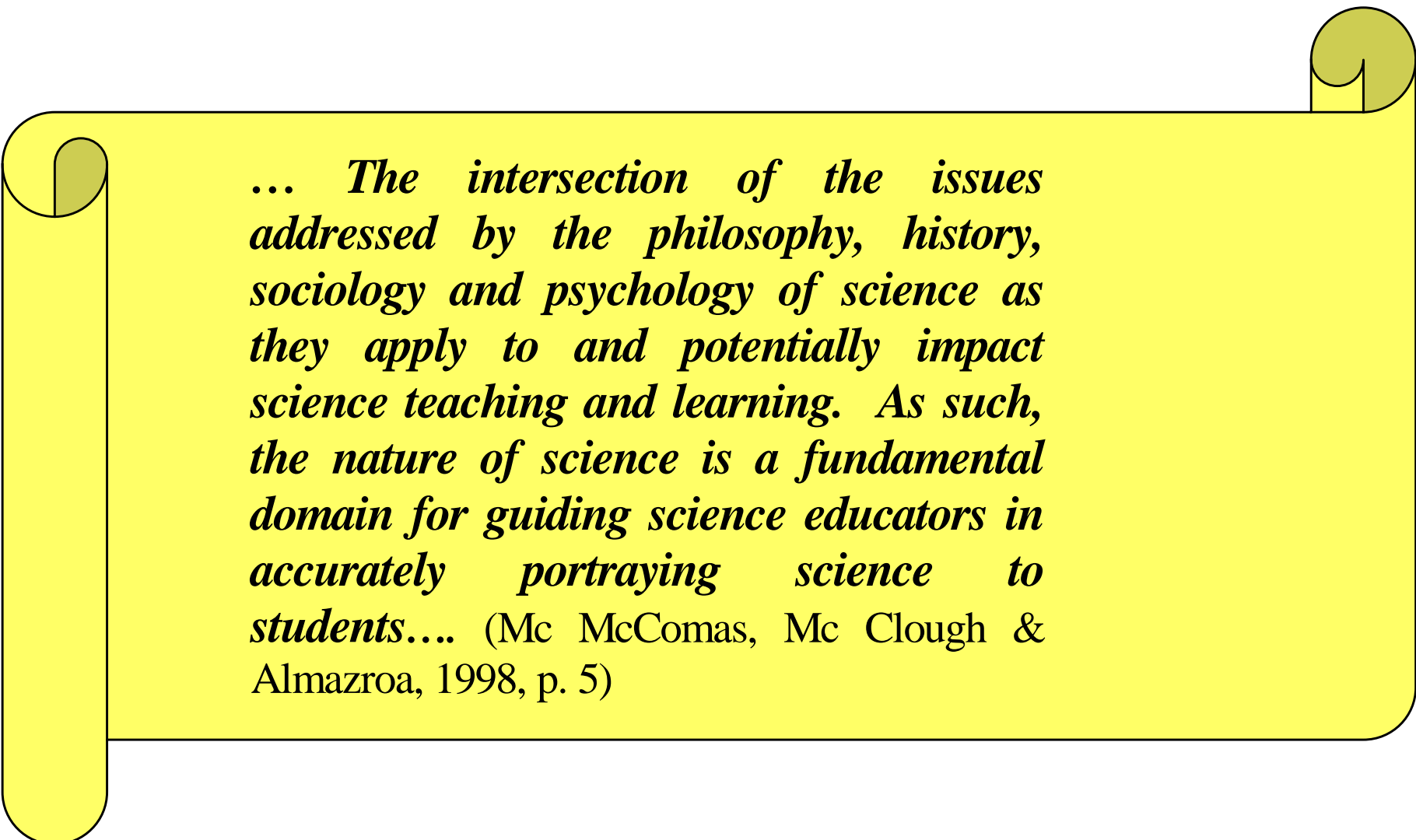
☒ *Processes accepted by scientific community*

⌘ Human Endeavour

☒ *Subjectivity & creativity*

⌘ Science and society

☒ *How one affects the other*



... The intersection of the issues addressed by the philosophy, history, sociology and psychology of science as they apply to and potentially impact science teaching and learning. As such, the nature of science is a fundamental domain for guiding science educators in accurately portraying science to students.... (Mc Comas, Mc Clough & Almazroa, 1998, p. 5)

Explicitly *teaching about* *NoS*

⌘ Explicit methods

☑ **NOT** didactic 'chalk & talk'

☑ **Is** reflection, discussion & hands-on activities...

Research Design: Phase 2



Beginning Teachers

Sample

2 Test
2 Control

Instruments

- Reflective Journals

Primary Children 3rd & 4th classes (8 - 11 years)

51 Test
53 Control

- Initial and exit questionnaires
- Initial and exit group interviews

Beginning Teachers



- ⌘ Positive about teaching science
- ⌘ Pupils were engaged in hands-on inquiry
- ⌘ Implementing Science Curriculum (DES, 1999)
- ⌘ Conscientious in planning

However ...

Beginning Teachers Explicitly Teaching NoS

Test Teachers

- *Contemporary NoS conceptions*
- *Maintained contemporary NoS conceptions year later*
- *Explicitly addressed NoS (not required to)*

Control Teachers

- *Unsophisticated NoS Conceptions*
- *Did not explicitly address NoS (some aspects implicitly addressed)*

Test Teachers Employed More Progressive Approaches

Variety of Methodologies

Test

Control

- | | | |
|---|---|---|
| <ul style="list-style-type: none"> • <i>Hands-on</i> • <i>Group work</i> • <i>Think and draw</i> • <i>Thinking Time</i> | <ul style="list-style-type: none"> • <i>Photos</i> • <i>Story</i> • <i>Drama</i> • <i>Teacher Demo.</i> | <ul style="list-style-type: none"> • <i>Hands - on</i> • <i>Teacher Demo.</i> |
|---|---|---|

Constructivist Approaches

Frequently ...

- *Contextualise Learning*
- *Finding out children's ideas*
- *Children testing ideas*
- *Assessing ideas*

Infrequently ...

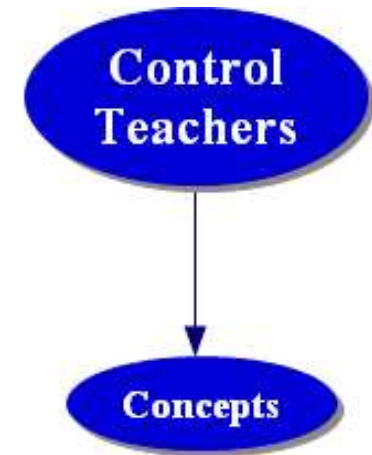
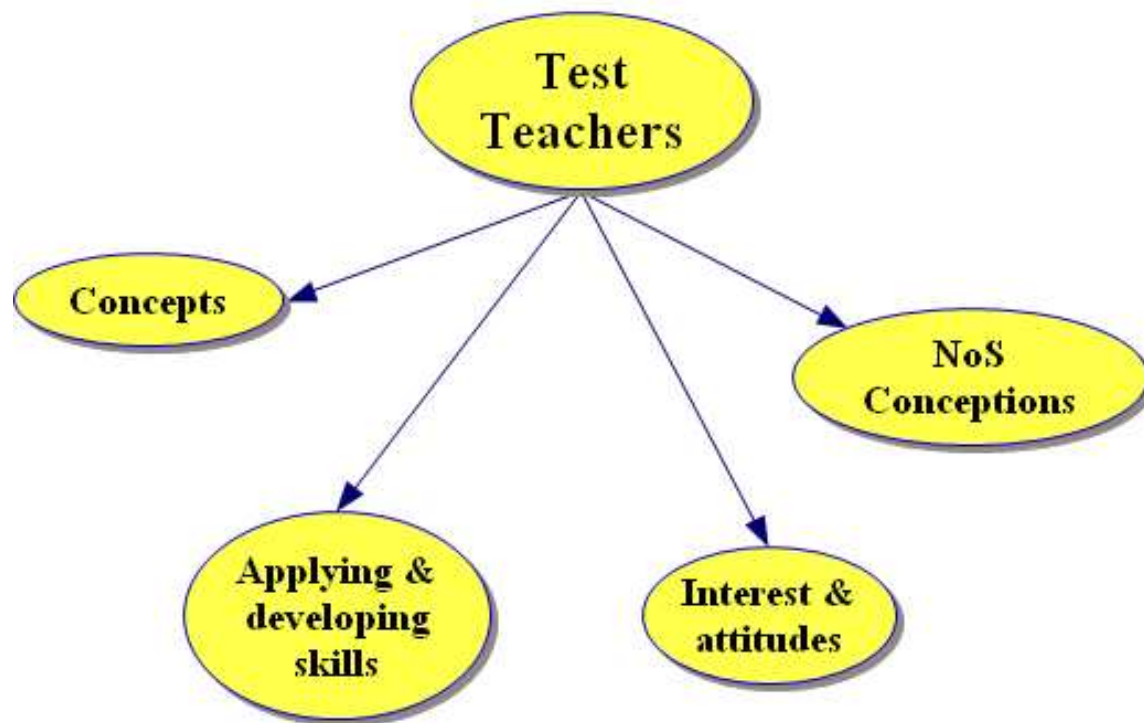
- *Finding out ideas*
- *Testing Ideas*

Discussion and Reflection in Science Class

- **Discussion and reflection central in all science classes**

- Discussion and reflection not central part of science class

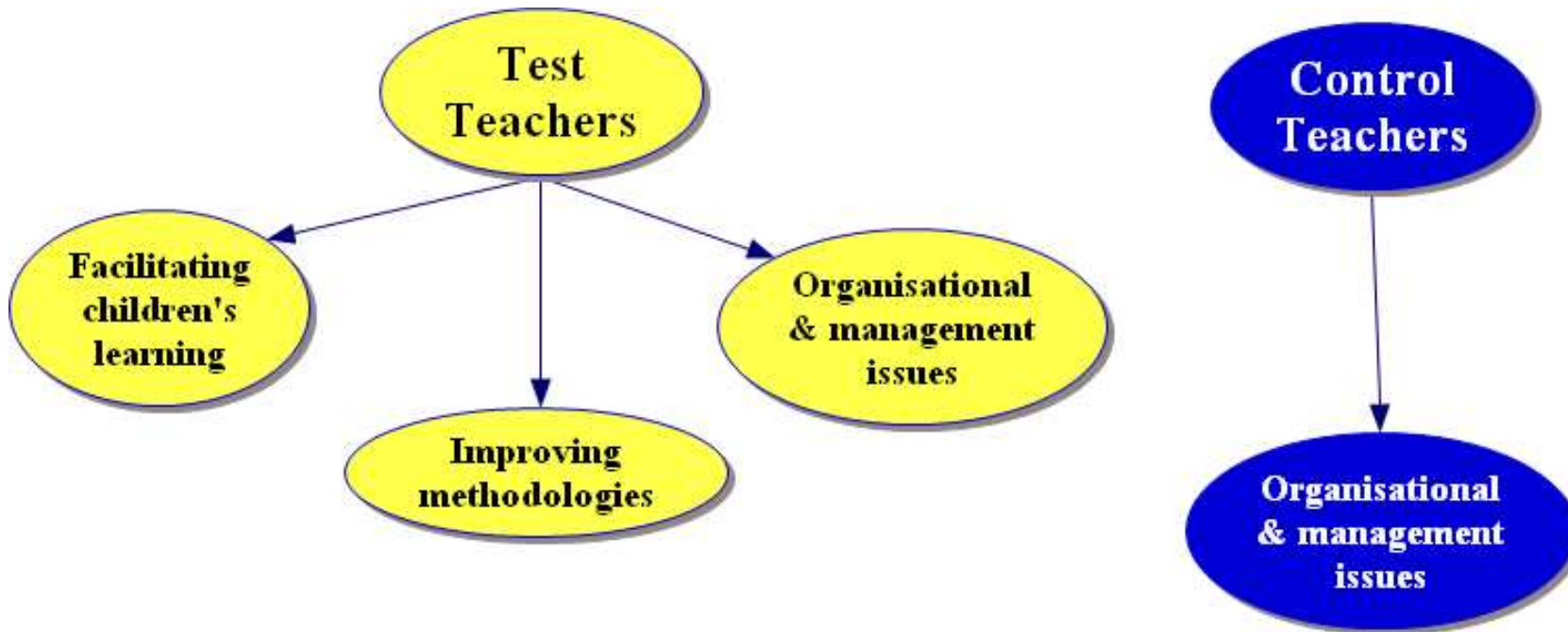
Reflections on Children's Learning



Reflecting on Children's Learning

"They enjoyed the role of investigating – being part of a team that gathers the evidence, observes it, analyses it and makes predictions/inferences based on the evidence...The incorporation of NoS has helped to give a human side to Science, to make it more accessible and enjoyable to the children by linking it with every day life, showing the effects that society played on the lives of famous scientists, how these scientists lived lives that were very similar to ours" (Test)

Reflective Practitioner



Reflective Practitioner

"I thought that I could have allowed the children to explore this scientist on the Internet by themselves and discover items or details that they would have been interested in discovering... I should have allowed them to guess or discover how this problem applies to scientists and their findings, rather than explaining it to them. But I felt at the time I really had to guide them or direct them to think about the work of a scientist in having this problem..."

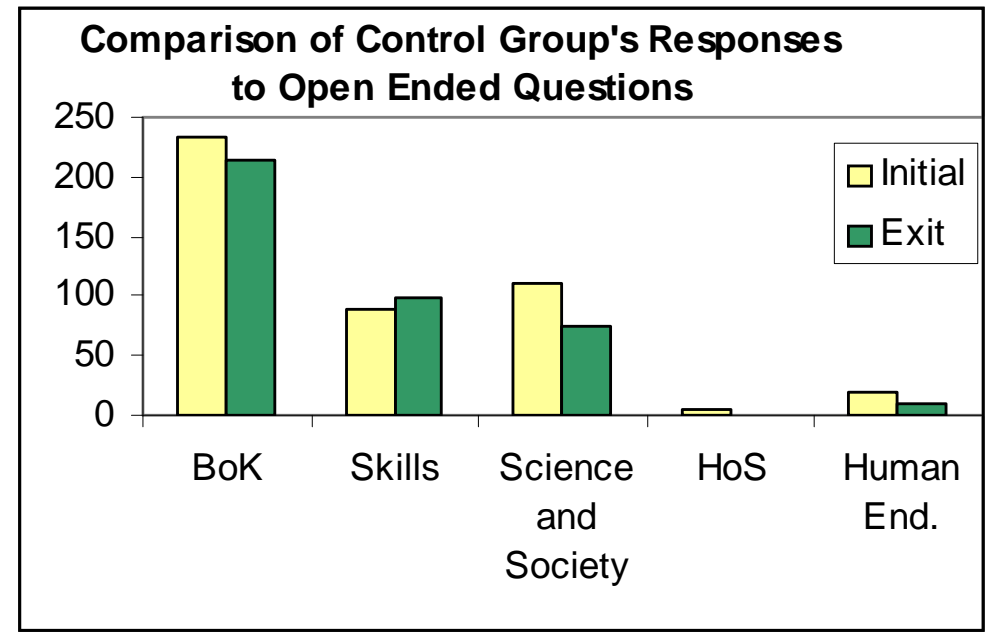
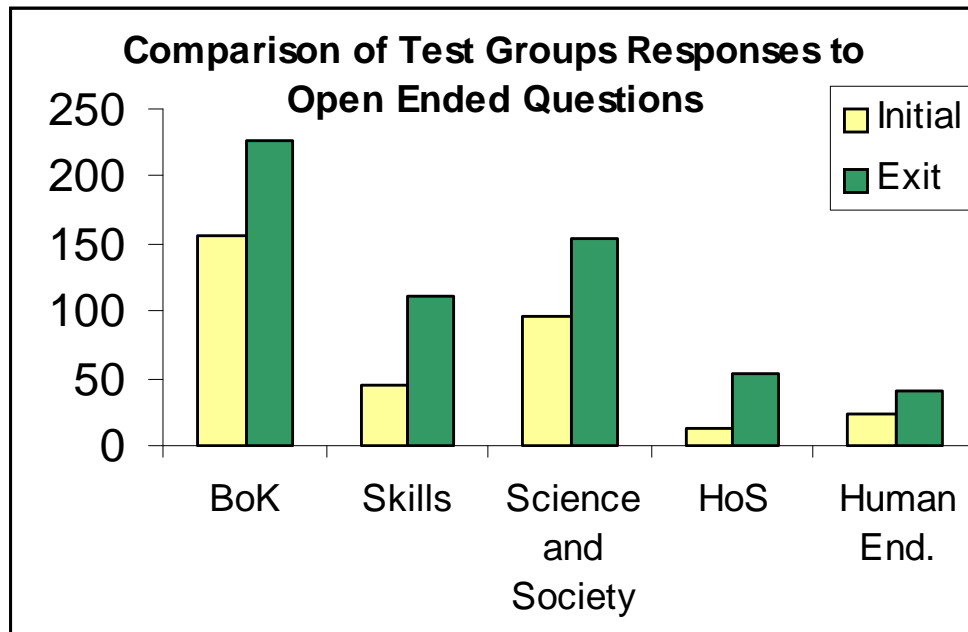
(Test)

Constructivist Approaches

"(strength of lesson)... not giving too much away and letting the children do the talking. Using concept maps and brainstorming the class on their prior knowledge of electricity. It brought up some interesting misconceptions but also gave a good point from which to start" (Test)

Children's Data

Test group developed more contemporary NoS conceptions ...



Contemporary NoS Conceptions

... scientists, can't always be right...like, C. said because when Galileo said that the world was round, and everybody didn't believe him cause they thought that the world was flat and then ...they locked him in his house, so ... he did a little bit, they all said that it was flat and then ... they found out ... cause they did experiments to see..." (Test)

Children's Reflections Regarding School Science

(Group Interviews)

Enthusiasm and Interest

Test

Control

- *Science is informative, interesting and fun*
- *Frequent references to school science*
- *Detailed recollections*

- *Science is informative, interesting and fun*
- *Infrequent references to school science*
- *Recollections not detailed*

Hands- On

- *Like hands-on*
- *Frequently referred to hands-on experiences*
- *Frequently referred to application of variety of science skills*

- *Like hands-on*
- *Rarely referred to hands-on experiences*

Reflection on NoS Activities

- *Frequently referred to NoS related activities*
- *Detailed recollections*
- *Linked abstract ideas with experiences*
- *Contemporary conceptions*

- *Did not refer to NoS related activities*

"You learn different activities and you learn how to turn on a bulb or a battery and stuff like that... We learn how air can blow up a balloon" (Control)

"We had to make a switch for a circuit... and me and C. and V. did a brilliant job. C. had this metal... and there was a metal bar, kind of like a right angle, and we had this swirly thingy, we swirled it up and we sello-taped all the wire onto the top of it, so when we turned it up to the top, the metal piece touched it, which lit the entire surface... so we (had to use our imagination) to make the switch" (Test)

So, Explicitly Teaching about NoS...

- ⌘ Effective in developing sophisticated NoS conceptions amongst *primary pupils*
- ⌘ More hands-on, reflective, constructivist approaches being employed
- ⌘ Greater interest and more positive attitudes (*teacher and pupils*)
- ⌘ Greater teacher confidence
- ⌘ Development of language and thinking skills