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Teaching argumentation in primary and secondary school science

This research comprises a series of studies about teachers learning to teach argumentation (including understanding the rationale for argumentation), developing the use of group work to support argumentation, understanding the teachers' role in argumentation activities, and activity design.

Key words: argumentation; school science; teacher development; group work; activity design

Key findings

Findings from these three studies are relevant to science educators, particularly those responsible for teachers' continuing professional development in both primary and secondary science.

Findings show that teachers need to engage with the nature of science (i.e. how we know what we know in science) as an important aspect of teaching science, and value an emphasis on the evidence base of science in their teaching. Most science teaching has traditionally placed more focus on established science content, rather than the process by which it becomes established. Teaching argumentation involves helping students to develop the skills of constructing arguments using evidence through classroom discussion, modelling the process and providing students with appropriate activities. The research shows that teachers find certain strategies for facilitating argumentation challenging:

- Organising and managing group work so that all students take an active role.
- Taking on a teaching role that encourages students listening to each other, taking a position, justifying an argument, counter-arguing and reflecting on an argument. Many teachers have to shift their normal classroom dialogue from providing the 'right answers' towards a more open approach that involves listening to students and asking questions.
- Adapting and designing activities that optimise the opportunities for students to engage in productive argumentation, such as concept cartoons, the use of puppets, competing theories, cards sorts (students work collaboratively to match, arrange or sort information on cards), and evidence statements.

Teachers need video, resources and collaborative reflection to support their learning.

What we did

All these studies were undertaken in England. Changes in the national curriculum emphasising the nature of science had been instigated in1989. However research focusing on science inquiry and classroom talk showed there was a need to develop resources and strategies to teach argumentation, with research to see the impact of interventions promoting this teaching.

Study 1: Economic and Social Research Council (ESRC) funded research on enhancing the quality of argument in secondary school science (based at King's College London, 1999-2002). Follow up study to produce in-service materials for secondary teachers, including video and resources, funded by Nuffield (2002-3). The outcomes from this study were used in the two subsequent studies.

Study 2: ESRC funded study to develop talking to learn through argumentation in secondary school science departments (2008-11).

Study 3: AstraZeneca Science Teachers Trust funded study to create and evaluate a website to support teachers' professional development in argumentation (2011– 12).

How we did it

Study 1: 12 secondary teachers attended workshops where they developed and shared resources and strategies. Classroom observations of teachers were recorded before and after the workshops (one year interval) and analysed using a framework derived from Toulmin's argument pattern.

Study 2: Eight teachers, two each from four secondary departments, attended workshops where they undertook professional development based on the outcomes of study 1, with a view to leading development in their schools. They were observed over a two year period and interviewed at one year intervals. Analytical frameworks developed in study 1 were used and interviews were coded according to perceptions of argumentation and changes in science department practice.

Study 3: Four primary and four secondary teachers attended workshops based on the outcomes of studies 1 and 2, whilst the website was developed. Data were collected on their views and use of the strategies in their practice through workshop observations and interviews.

Further information

The research has culminated in a number of research publications in education journals and also in-service materials for teachers that are available on two websites:

National Stem Centre – IDEAS Resources

National Stem Centre – ideas, Evidence and Argument in Science (IDEAS Pack)

Primary Science Teaching Trust (PSTT) –Teaching Argumentation in Science

The most recent site (at pstt.org) provides a useful starting point for the further professional development of science teachers and also research into the efficacy of strategies for teachers learning to teach argumentation in school science.

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