Learning to Argue and Arguing to Learn

Developing Scientific Argumentation Skills in Pre-service Chemistry Teachers

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KEY IMPLICATIONS

1. Explicit instruction of argumentation structure to pre-service teachers helps them better understand about learning through argumentation.
2. Prior foundational knowledge about the topic is necessary for meaningful engagement in argumentation.
3. Information packages with materials relevant to the topic of discussion help to focus the discussion within limited class time.

BACKGROUND

The discipline of science is characterised by the evaluation of knowledge claims that are supported by available evidences. One of the key attributes of a scientist is the ability to discern relevant and orthodoxy evidence from those that are irrelevant and outdated, and use these evidences to construct coherent arguments (Osborne, 2010). As such, it is important for pre-service science teachers to be equipped with the knowledge and skills of how to use argumentation to facilitate the learning of their prospective students.

FOCUS OF STUDY

To equip pre-service teachers with skills and knowledge to teach argumentation and to teach

with argumentation, we need to understand what pre-service teachers know about scientific argumentation and to what extent they value its role in the teaching and learning of science. Pre-service teachers were tasked to work through various tasks that were crafted using the principle of conflicting theories and they were asked to decide on the theory that is more viable.

KEY FINDINGS

1. Pre-service teachers without foundational knowledge of medicinal chemistry are able to learn the content of medicinal chemistry through engaging in argumentation discussion with their peers.
2. During argumentation, the pre-service teachers in this study engage in 12 forms of interactions: (1) agreement, (2) stating claims, (3) clarification, (4) explanation, (5) figuring it out loud, (6) information sharing, (7) offering alternatives, (8) giving perspective, (9) persuasion, (10) disagreement, (11) raising strategic questions, and (12) raising procedural questions.
3. The interaction patterns for the two different groups of pre-service teachers were different.

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4. To facilitate their learning through argumentation, pre-service teachers refer to resources such as the information pack provided with the tasks (these include key chapters from three different types of textbooks ranging from "O" levels, "A" levels and university texts), online sources, worksheets that were provided and the lecturer. Given the fixed time frame available for task completion, the information pack provided was widely used as a resource.

SIGNIFICANCE OF FINDINGS

Policies can be put in place to encourage:

1. The explicit teaching of argumentation structures to pre-service science teachers and the application of argumentation in their own learning.
2. Science educators to actively design tasks that are argumentation-centered so that pre-service teachers can be more comfortable with this form of learning.

From our findings, we suggest that:

1. Teachers should ensure that students have some foundational level knowledge of the topic before they can engage in meaningful argumentation discussion in science. Hence, argumentation can be used as a means to teach and check application of scientific ideas learnt.
2. Teachers can prepare information packages containing materials reflecting different points of views about the knowledge in question to facilitate students' discussions. These information packages help students to focus their discussions and decision making given the limited time frames for discussion within a class period in school.

POPULATION

The pre-service teachers who participated in this study belongs to students enrolled in two different programs: (1) Year 4 students enrolled in a Bachelor of Science (Education) program, and (2) Students enrolled in the 1-year Post-Graduate Diploma in Education program. These students were purposively sampled as they were enrolled in the medicinal chemistry course as well as the methods course on the teaching of biology.

RESEARCH DESIGN

This study is qualitative in nature and adopted the research methods of classroom observation, video recording, interviews with participants as well as a pre- and post-test questionnaire to assess participants' knowledge gain. The pre-service teachers were engaged with the six tasks that were developed for medicinal chemistry. As they work through these tasks, their discussions and questions were analysed and these formed one of the data sources for this study. Interviews were also carried out and transcribed to augment our understanding of the pre-service teachers' experiences and ideas about argumentation. Their gains in knowledge were measured using pre- and post-test questions designed around the topic of argumentation.

REFERENCE

Osborne, J. (2010). Arguing to learn in science: The role of collaborative, critical discourse. *Science*, *328*(5977), 463–466.

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