

Using analogies in chemistry teaching: a case study of a teacher's preparations, presentations and reflections

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1. Introduction

Some teachers often use analogies to describe and explain difficult science phenomena. Teachers' analogies exhibit a rich variety of form and content (Dagher, 1995) and teacher analogies can be planned or spontaneous (Thiele & Treagust, 1994). Successful analogies are systematic, include multiple mappings and utilise relational thinking (Gentner & Medina, 1998). Pictorial and role-play analogies are frequently used to enhance analogical familiarity but few teachers discuss analogical limitations.

The use of analogies by teachers is influenced, among other things, by their existing knowledge base, especially by their pedagogical content knowledge (PCK). Important PCK components are: (a) knowledge of specific instructional strategies, knowledge of multiple representations (models and analogies) and activities (e.g. demonstrations); and (b) knowledge of student prior knowledge of a topic and known student learning difficulties (see Gess-Newsome & Lederman, 1999). The relationship between teachers' PCK and teachers' classroom practice is reciprocal: teachers' PCK affects their lesson preparation and classroom decisions and their teaching activities influence their PCK. The latter influence can be enhanced by stimulating teachers to reflect on their own teaching (Osborne, 1998).

With respect to teaching with analogies, little is known about the relationship between teachers' classroom practice and their PCK before teaching and after teaching. Harrison (2001) explored teachers' knowledge in interviews but did not observe their teaching. The present case study explores this relationship by asking the following research questions:

1. What correspondences and differences between a teacher's intentions and his/her practice can be identified when teaching with analogies?
2. How can teacher reflections on their intentions and teaching with analogies enhance their explanations in science?

Answers to these questions help us understand how and why science teachers' use analogies in the classroom and suggest which analogies are most effective for specific content.

2. Method

A chemistry teacher with 16 years experience participated in this case study. The Grade-12 chemistry lessons we studied treated reaction rates, reversible reactions and equilibrium. Before each lesson, the teacher was interviewed about his intentions, while, after each lesson, the teacher was interviewed about his reflections on his teaching. The interviews mostly focused on the use of analogies for illustrating or explaining relevant chemistry concepts. The lessons and interviews were audio taped and transcribed and the transcripts were analysed individually by both authors. Using investigator triangulation

(Janesick, 1994), the analyses were compared and discussed until consensus was established concerning the in-class interactions and the teacher's analogical explanations.

3. Results

In all, the teacher presented seven analogies to his students. The analysis indicates the following correspondences and differences between the teacher's intentions and his classroom practice. The teacher

- * intended locating his analogies in the students' interest-zone. This he did by using the "busy-highway" analogy and the "dance-commitment room" analogies to illustrate the dynamic nature of reversible reactions and the equilibrium that can exist between reactants and products.

- * intended to use analogies to better understand the submicroscopic world by helping the students visualize particle interactions. Five combined oral and pictorial analogies were presented.

- * intended to pay attention to limitations of the analogies by inviting the students to find where the analogies break down. He did not explore the analogical limitations of five analogies.

- * intended to check students' understanding of the analogies by asking them to retell the links between a particular analog and target in their own words. For six analogies, he did not.

The analysis reveals that the teacher was aware, after teaching, of the correspondences between his intentions and classroom practice. He also became aware of students' difficulties in understanding the "busy-highway" analogy. For that reason, he intended to replace this analogy by a simpler and better-structured one: the "car park" analogy. The teacher was not aware of the differences between his intentions and his classroom practice, as mentioned above.

4. Conclusion and implications

The teacher was very experienced in telling analogical stories. For that reason, it is not very surprising to find a number of correspondences between his intentions and classroom practice. For the same reason, it is very interesting to find a number of specific differences, especially the absence of his intended attention to the limitations of specific analogies, and the absence of his intended check of students' understanding of links between an analog and its target. These results underline the need to pay attention to specific aspects of teaching with analogies in the context of pre-service and in-service teacher education. The present explanatory study was small-scale. The study, will be broadened in 2003 by involving more teachers, and by incorporating the teaching of a wider range of science topics that include the use of analogies. The presentation will enable us to critically reflect, with the audience, on this research.

5. Bibliography

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