A Guided Inquiry Approach to Teaching Year 6 Electricity

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Abstract.

This paper researched the challenges and successes in adopting a guided inquiry Representation Construction Approach (RCA) to the teaching of electrical circuits to Year 6 students. A case study involving a design based research method was employed with data that included classroom video, teacher and student interviews, student journal entries and assessment artefacts, field notes and pre/post-tests. The students gained considerable insights into electrical circuit processes through creating, negotiating and critiquing a range of representations. A challenge for the teacher was in the development of ideas beginning from a energy perspective before introducing electrons as carriers of energy.

1 Introduction

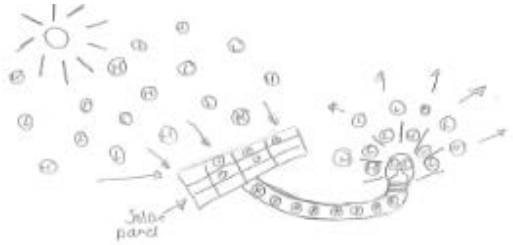
The teaching of electrical circuits to Year 6 students is mandated in the Australian Curriculum, and whilst electrical phenomena is familiar to primary students, the abstract nature of the underlying processes involved in electric circuits poses challenges for teaching and learning at this level [1]. Given that inquiry-based approaches may lead to enhanced student engagement and learning of science this paper describes the efforts of a primary school teacher in adopting a guided inquiry approach, called Representation Construction Approach (RCA), in teaching electical circuits to her Year 6 class. RCA has been developed and trialled over a 9-year programme of research which students, through constructing and evaluating representations, are led to understand and appreciate, and productively employ scientific representations [2]. Whilst the study explored student learning outcomes in addition to the teaching approach this paper has a focus on the teaching. The research question is: What are the pedagogical implications and challenges for a primary school teacher in using a RCA to teaching electricity?

2 Methodology

The methodology was a single case study, which adopted design-based research that involves an interactive process of development and trialling, and evaluating outcomes and is conducted with the teacher as partner in the process [3]. The case was an independent metropolitan girls' primary school with a specialist science teacher who taught two Year 6 classes in the study. Prior to the topic being taught the researchers introduced the key elements of RCA and then collaborated with the teacher in planning activities with a representational focus. In line with design-based research, evaluation and modification occured during, and following, the six week lesson sequence (one hour lesson each week), which was delivered a second time in the following year. Data included video of classroom practice, teacher and student interviews, student journal entries and assessment artefacts, field notes (2nd author sat in on the classes) and, pre- and post-tests.

3 Results and Discussion

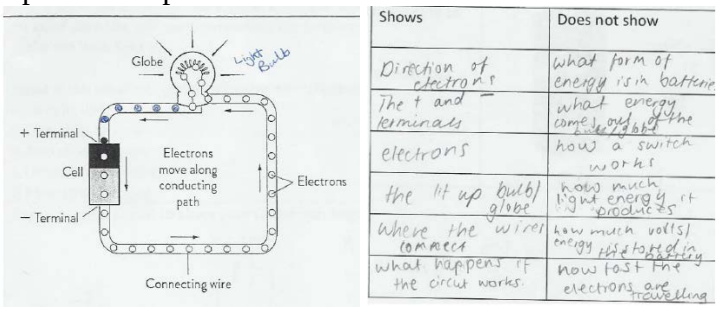
The data showed that students gained good insights into the underlying processes of energy transfer and transformation, and electron flow, to explain the operation of electric circuits. This was achieved through representational activities and discussions that first of all established key ideas associated with energy transfer and transformation before introducing causal models of energy transfer that involve electron flow (see Fig. 1 for a student's response to a task).



L light energy
H heat energy
K kinetic energy

Fig. 1 Representation of energy changes in one way electricity can be generated

The RCA emphasises that any one representation is only partial in its explanatory power, which lead to representational activities whereby students would not only critique their own and fellow students' representations but also the canonical representations (see Fig. 2). A final summative task required students to construct a 3-D model of an electric circuit whereby they made decisions as to what the model might represent and not represent. RCA afforded the students' use of learning journals which captured their developing ideas and reflections in response to representations tasks.



Shows
Direction of electrons
The + and – terminals
Electrons
The lit up bulb/globe
What happens of the circuit works
Does not show
What forms of energy are in the battery
What energy comes out of the bulb/globe
How much light energy is produced
How much volts/energy is stored in battery
How fast the electrons are travelling

Fig. 2 Critique of an electrical circuit diagram (final test question)

A challenge for the teacher was in finding the balance between challenging the students to generate their own representations and introducing the canonical representations that explain the abstract processes underpinning electric circuits.

4 Conclusion

The students gained good insights into electrical circuit processes through creating, negotiating and critiquing a range of representations. A challenge for the teacher was in 'holding back', allowing students to do their own thinking, then consolidating to develop ideas, beginning from a energy perspective before introducing electrons as carriers of energy.

5 References

[1]T. Jaakkola, S. Nurmi and K. Veermans, A comparison of students' conceptual understanding of electric circuits in simulation only and simulation laboratory contexts, *Journal of Research in Science Teaching,* **48**(1), (2011) 71–93.

[2]P. Hubber, R.Tytler and G. Chittleborough, Representation Construction: A Guided Inquiry Approach for Science Education, In Jorgensen, R., Kanasa, H. & Larkin, K. (eds.) *STEM education in the Junior Secondary - The state of play*, Springer Nature, Singapore, (2018) 57-89.