Resource Review

Constructing Representations to Learn in Science

Russell Tytler, Vaughan Prain, Peter Hubber and Bruce Waldrip (Eds).

Review by Louise Bennetts, Coordinator, Science KLA, Trinity Catholic College, Goulburn

Constructing Representations to Learn in Science is a collection of research reports presenting evidence of the effectiveness for student learning using student-generated representations to document, explain, justify and demonstrate understandings in middle school units that had been identified as presenting challenges to teachers. These units were 'Animals in the school ground', 'Changes to matter for primary school students', 'Astronomy, force and motion' and 'Molecular models of matter for lower secondary students'.

Combining evidence from some preliminary classroom observations and teacher feedback with previous research, a framework for unit planning based around student-constructed representations was developed. The researchers then worked with the teachers over a period of three years for them to be able to use this framework to construct the units whose programming and implementation in the classroom were the focus of the research.

The data was collected from videos taken of both teachers and students in the classroom, from interviews with teachers and students, and from the collection of student workbooks. The teachers were provided with ongoing feedback and support to help with their lesson planning within the units. The teachers indicated that they had benefited from the extensive support and professional development they had received throughout the research period, but their feedback suggested that this level of supported implementation of the student-generated representations model would not be sustainable for most schools. The researchers included some supplementary evidence to indicate that they had provided short-term professional learning to other groups of teachers who achieved similar results with their students as the original long-term groups of teachers.

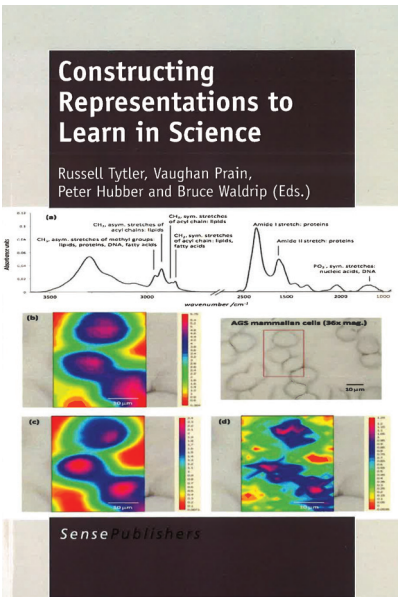
The analysis of the data collected, forming the main content of the book, indicates that the use of student-constructed representations, within the framework developed by the authors, has much that is relevant to contemporary pedagogy as required by the inquiry-based focus of the Australian Curriculum. Although there is only one reference to the Australian Curriculum: Science (ACS), and that is towards the end of the book, there are many aspects of the representational approach that could be used to assist students achieve a number of the ACS outcomes. These include the Science as a Human Endeavour (in relation to new evidence informing and changing knowledge; the collaborative nature of Science) and Science Inquiry Skills (presenting, evaluating and communicating) strands.

The benefits to students as described in the book include the active role the students play in developing their own representations, and as such constructing their own knowledge, as contributing to improving student engagement. There are benefits for the development of scientific literacy as students have to label their representations and explain what they

are intending to demonstrate. Recent publication of the PISA data identified a reduction in literacy in Australian students over the last 10 years (OECD, 2012). The use of representations may be one of a range of strategies that teachers can use to address this issue.

It is possible for students to demonstrate their understanding of a particular concept with a representation before they have had the opportunity to develop the metalanguage to verbally explain it. This can be an effective technique for students with special needs related to language to demonstrate their learning, and so receive the motivational feedback that will help to keep them engaged and learning.

Communication is enhanced when the students, either individually or as part of a group, are required by the process to present and explain their representations to the class. Their peers provide feedback as to the efficacy of the representation, so enabling the students to reflect on their effort, and to improve on it.



The inclusion of opportunities to evaluate and refine the representations also allows teachers to suggest increases to the complexity of the representation, thereby making the activity more challenging.

The authors provide evidence of the technique being used successfully to demonstrate reasoning and problem-solving. This is an area of higher order thinking that is assessed by the TIMMS survey (TIMMS, 2011), and is an area that is not always effectively developed by more traditional textbook-focused pedagogies.

Another significant claim made by the authors in support of this technique is that the process of collaborating, evaluating, refining and redeveloping student-constructed representations reflects the process of science itself, so providing students with an authentic experience of science practice embedded in the learning process of each unit.

Representations are seen as both a process and a product of learning. As such, there was evidence presented that their use can be a part of formative assessment. When summative assessment was used by the researchers at the end of the units, as part of their evaluation process with the case studies, improved learning between the diagnostic and summative assessments was observed.

This is an academic publication in which the rationale, methodology and analysis of the research is supported by the data collected and reported on, and by the substantial references provided throughout each of the chapters.

Although there is no index for this book, the Table of Contents includes both the title of each chapter and the name of the sections within each chapter. Examination of the Table of Contents provides an overview of the research at various stages, from the rationale for the focus of their research to the implications of that and related research for the future, so it is possible to use that structure to find specific broader aspects of the research.

There is much to recommend this book, particularly for students studying science teaching methodology. It would also be a suitable reference book for a Science faculty library as a resource for additional strategies to improve the levels of engagement, literacy and communication skills of students, and to provide the students with opportunities to use higher-order thinking skills in formative assessment.

REFERENCES

ACARA (2012) The Australian Curriculum v5.1 Science Foundation to Year 10 Curriculum.

www.australiancurriculum.edu.au/science/curriculum/f-10#level7 retrieved 7 December, 2013.

OECD (2012): from http://www.acer.edu.au/ozpisa/science/retrieved 7 December, 2013.

TIMMS (2011): from http://timss.bc.edu/timss2011/downloads/TIMSS2011_Frameworks-Chapter2.pdf retrieved 7 December, 2013.