

## Chapter 12

# Multiliteracies in Secondary Chemistry: A Model for Using Digital Technologies to Scaffold the Development of Students' Chemical Literacy

**Annette Hilton**

*University of Queensland, and CRC Sugar Industry Innovation through Biotechnology, Australia*

**Kim Nichols**

*University of Queensland, and CRC Sugar Industry Innovation through Biotechnology, Australia*

**Christina Gitsaki**

*University of Queensland, and CRC Sugar Industry Innovation through Biotechnology, Australia*

### **ABSTRACT**

*Digital technologies can play an important and significant role in improving students' understanding and literacies (e.g., visual, digital, and critical literacies). To develop such multiliteracy skills, students need opportunities to process and communicate information or use specialised representations that characterise a subject area, often through multiple modalities. Digital technologies are important learning tools for helping students to interpret and communicate information multimodally. In chemistry, in particular, digital technologies are effective tools for supporting students' understanding and representation of chemical concepts on macroscopic, molecular, and symbolic levels. Designing and scaffolding appropriate learning experiences in chemistry can be a challenge for teachers, particularly when integrating digital technologies with laboratory-based activities. The purpose of this chapter is to outline how a multiliteracies framework can be used to develop and deliver an investigative inquiry unit of work to chemistry students. It describes a scaffolding model developed and investigated through a study in which an introductory unit in senior chemistry was taught using a multiliteracies approach. It also describes student learning outcomes and perceptions of the usefulness of this scaffolding approach as these were identified through the study.*

DOI: 10.4018/978-1-60566-673-0.ch012

## INTRODUCTION

Many concepts and phenomena in chemistry are abstract and unobservable and can only be understood and communicated through the use of chemical representations or models. Such representations are used by scientists on three levels: macroscopic—representations of phenomena that are observable, molecular—visual representations showing the structure or behaviour of particles, and symbolic—signs and symbols used to represent particles and their behaviour (Vermaat, Terlouw & Dijkstra, 2003; Wu & Shah, 2004). To achieve an understanding of abstract and complex concepts in chemistry, students need to be able to use multiple representations in a number of ways, something that often causes difficulties (Gabel, 1999; Johnstone, 1996; Kozma, Chin, Russell & Marx, 2000; Lemke, 2000; Schank & Kozma, 2002). Grasping the complexity of meaning in chemistry requires students not only to understand individual representations but to integrate simultaneously multiple representations in a variety of modes (Lemke, 2000). For example, students may need to interpret teachers' gestures, written and verbal explanations, digital or physical models, video clips, graphs and tables, numerical data, or symbolic representations. A further challenge for students is the use of multiple representations to explain macroscopic phenomena on the molecular level, as they might be required to do when discussing experimental observations. This process requires students to be familiar with a range of chemical representations and to understand their inherent meaning, to be able to use representations to investigate and interpret macroscopic phenomena, and to be able to integrate and transform representations, linking them together in a range of appropriate genres to communicate information.

The ability to read and produce text using a variety of available media and modes, known as multiliteracies (Williamson, 2005), has implications for the teaching of chemistry and the role

literacy education plays in the development of students' understanding of chemistry and chemical representations. The ways in which we ask students to represent their understanding should also reflect the changing nature of communications used by today's scientists in their daily work (e.g., molecular models, digital representations of data, analysis, and explanatory information). In today's classrooms, literacy pedagogy should account for the role of multiple modes of meaning-making including electronic media texts (Cope & Kalantzis, 2000; Jewitt, 2006; Prain, 2006; The New London Group, 2000; Unsworth, 2006) and this is certainly the case in chemistry since so many representations are generated using digital technologies.

Increased student access to computers in schools and the affordances of digital technologies provide opportunities for students to use multimedia and visualisation software. Such software can often be freely accessed on the Internet, and can extend the range of available representations students use to interpret findings and to choose appropriate representations to demonstrate their understanding using multimodal texts. These resources also have the potential to enhance students' understanding of abstract concepts.

To highlight the changing and increasingly complex nature of literacies in today's world, the New London Group (2000) proposed the multiliteracies framework. This framework emphasises the proliferation of ways in which meaning making occurs multimodally and the increasing influence of cultural and linguistic diversity both locally and globally. The framework also provides a useful structure for designing learning experiences in chemistry, where it is becoming increasingly recognised that students benefit from making and representing meaning through integration of multiple modes of representation (Michalchik, Rosenquist, Kozma, Kreikemeier & Schank, 2008). A multiliteracies approach allows teachers to focus on students' literacy development and knowledge construction, particularly in laboratory

21 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

[www.igi-global.com/chapter/multiliteracies-secondary-chemistry/36130](http://www.igi-global.com/chapter/multiliteracies-secondary-chemistry/36130)

## Related Content

---

### Is It Accessible?: Ensuring Accessibility in Higher Education During a Global Pandemic

Michael John Kutnak (2021). *Handbook of Research on Lessons Learned From Transitioning to Virtual Classrooms During a Pandemic* (pp. 358-377).

[www.irma-international.org/chapter/is-it-accessible/276235](http://www.irma-international.org/chapter/is-it-accessible/276235)

### But Do They Want Us in “Their” World?: Evaluating the Types of Academic Information Students Want through Mobile and Social Media

Tim Brown and Amanda Groff (2012). *Virtual Learning Environments: Concepts, Methodologies, Tools and Applications* (pp. 1353-1369).

[www.irma-international.org/chapter/they-want-their-world/63197](http://www.irma-international.org/chapter/they-want-their-world/63197)

### Identification of Key Issues in Adopting a Web 2.0 E-Portfolio Strategy

Gary F. McKenna and Mark H. Stansfield (2013). *International Journal of Virtual and Personal Learning Environments* (pp. 49-64).

[www.irma-international.org/article/identification-key-issues-adopting-web/76373](http://www.irma-international.org/article/identification-key-issues-adopting-web/76373)

### Identification of Key Issues in Adopting a Web 2.0 E-Portfolio Strategy

Gary F. McKenna and Mark H. Stansfield (2013). *International Journal of Virtual and Personal Learning Environments* (pp. 49-64).

[www.irma-international.org/article/identification-key-issues-adopting-web/76373](http://www.irma-international.org/article/identification-key-issues-adopting-web/76373)

### 3D Virtual Learning Environment for Engineering Students

M. Valizadeh, B. Noroozi and G. A. Sorial (2012). *Virtual Learning Environments: Concepts, Methodologies, Tools and Applications* (pp. 859-869).

[www.irma-international.org/chapter/virtual-learning-environment-engineering-students/63167](http://www.irma-international.org/chapter/virtual-learning-environment-engineering-students/63167)