



Enhancing pre-service teachers' concept of Earth Science through an immersive, conceptual museum learning program (Reconceptualising Rocks)

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HIGHLIGHTS

- Learning Experience Model for the contextual learning at the museum.
- Contemporary museum and scientific practices transfer into educational purposes.
- Implications for teaching Earth Science in secondary schools.

ARTICLE INFO

Article history:

Received 24 August 2016

Received in revised form

26 May 2017

Accepted 11 June 2017

Keywords:

Earth Science

Contextual learning

Pre-service teacher

Education

Learning experience model

Field trip

Museum Victoria

ABSTRACT

The collaboration between Museum Victoria and ReMSTEP partners: the University of Melbourne and Deakin University has enabled the development of the Reconceptualising Rocks project, designed to enhance the teaching of Earth Science for pre-service Science teachers. This study sought to determine how perceptions and understandings of Earth Science could be enhanced through immersion in the contextual learning in the Museum. Furthermore, the project aimed to explore how science ideas and practices can be translated for educational purposes. The findings revealed that participants found Earth Science interesting and were able to identify links to other Science areas. These findings have implications for the teaching of Earth Science across the curriculum.

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1. Introduction

There has been widespread concern nationally and

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internationally about the engagement of students with school science and the subsequent uptake of science and technology in the post compulsory years of schooling for some time (Gago, 2004; Tytler, 2007). A diminished uptake of student enrolments in pre-service secondary science and technology education courses has contributed to the current shortages of suitably qualified teachers in Australian secondary school subjects of science and technology (Weldon, 2015).

Declining student engagement with science has shifted the focus on the need for a change in the quality of science teaching. Much of the impetus for change comes from research findings that

students find school science irrelevant and un-engaging due to a prevailing, transmissive pedagogy, and subject content they do not relate to (Goodrum, Hackling, & Rennie, 2001; Lyons 2006).

Tyler (2007) has argued for a re-imagined science curriculum that represents the contemporary practices of science and its links with human endeavours. This position is adopted in the Australian Science Curriculum (ACARA 2012) which has an explicit reform agenda for more inquiry-based teaching and learning of science which emphasises science investigative skills, inquiry, context, contemporary science and its human dimensions.

In response to a report by Professor Ian Chubb AC, former Australia's Chief Scientist (Chubb 2012) calling for more funding to support quality teaching in Australian schools, the Australian Government has committed 54 million dollars over four years towards the 'Investing in Science and Maths for a Smarter Future' initiative (<http://archive.industry.gov.au/ministerarchive2013/chrisevans/mediareleases/pages/investinginscienceandmathsforasmarterfuture.aspx.htm>). This initiative aims 'to provide more science and mathematics teachers, equipped with better training and better resources, to enter Australia's schools'. One of the programs in this initiative is the Office for Learning and Teaching (OLT) program Enhancing the Training of Mathematics and Science Teachers Programme (<http://www.olt.gov.au/math-and-science-teachers>), which has sought to drive 'a major improvement in the quality of mathematics and science teachers by supporting new pre-service programs in which faculties, schools or departments of science, mathematics and education collaborate on course design and delivery, combining content and pedagogy so that mathematics and science are taught as dynamic, forward-looking and collaborative human endeavours.' More than twelve million dollars has been allocated for this program which consists of five major projects across Australia; including Reconceptualising Maths and Science Teacher Education Programs (ReMSTEP; funded at 3.2 million dollars). One of the projects within ReMSTEP is the context for this article.

1.1. ReMSTEP (<http://remstep.org.au/>)

ReMSTEP is a three year collaborative project led by the University of Melbourne in association with Deakin, La Trobe and Monash universities. Activities within ReMSTEP are centred on developing new teacher education practices that align contemporary approaches to STEM with engaging teaching and learning. Importance is placed on activities that build collaborative relationships across education and science faculties, universities and specialist science and mathematics centres. These partnerships will drive major improvements in the quality of mathematics and science learning and teaching by creating programs where undergraduate STEM students and pre-service teachers work collaboratively across faculties and specialist centres to create new materials, units of study and expertise in inquiry-based classroom practices. It is this collaboration and embedding of the experience into pre-service programs that are key factors in the successful implementation of ReMSTEP. One of the collaborative partnership activities within ReMSTEP is the Reconceptualising Rocks project.

1.2. Reconceptualising Rocks

Reconceptualising Rocks is a collaboration of Deakin University, the University of Melbourne and Museum Victoria (<http://museumvictoria.com.au/>). Museum Victoria is the preeminent source of communicating science to Victorians, based on a legacy of two major public science facilities, Melbourne Museum and Scienceworks. Museum Victoria houses 18 million collection items for science education staff, which includes scientists who research the

diversity and origins of the fauna and geology of Australia. Apart from researching the existing collections, the museum has active field programs that further develop the collections. All of the scientists' work leads to research publications, books, websites, apps, museum exhibition and documentaries.

The scientific context for the Reconceptualising Rocks project, as its title suggests, is Geoscience. Pre-service secondary teachers from the University of Melbourne and Deakin University participated in a partnership model whereby students undertook immersion experiences at the Melbourne Museum, one of the three museums incorporated under the umbrella of Museum Victoria, in addition to a field experience. The participants worked with education staff and the resident geologist with the intention of producing curriculum materials to support the teaching of Geoscience as described in the Australian Science Curriculum (ACARA, 2012). Details of the partnership model are given below.

The research literature indicates that Geoscience as a discipline is underrepresented at the post-compulsory years of secondary schooling (King, 2008) but has a strong focus in the Year 8–9 Science Curriculum (ACARA, 2012). It is therefore important for teachers to have content knowledge of Geoscience despite often having limited opportunities to undertake Geoscience within their undergraduate Science course.

The prevalence of alternative conceptions in Geoscience has significant implications for the pedagogical approach used in the classroom. Apart from having a strong content knowledge, it is argued that teachers implement inquiry-based approaches (King, 2008) that not only engage students but also develop their scientific thinking.

The Reconceptualising Rocks project has the dual aims of increasing pre-service teachers' understanding of Geoscience processes and the role of scientists in undertaking contemporary Geoscience. In addition, the project aims to find a sustainable partnership model for pre-service teachers to translate science ideas and practices for improving the teaching of Earth Science in secondary schools.

1.3. Research questions

The following research questions are based on a partnership model, which connects pre-service teachers to scientists, science research and practice.

1. In what ways does the project enhance pre-service teachers' perceptions of Earth Science and the way Earth Science might be taught in schools?
2. How does the collaboration between Museum Victoria and pre-service teachers translate science ideas and practices for educational purposes in Earth Science?

2. Literature review

2.1. Earth science as an underdeveloped area of the curriculum

Geoscience falls under the umbrella of Earth and space science subjects. Internationally geoscience seems to be increasingly prominent in schools from international survey responses and curricula exemplars. King (2008, 2013, 2015) has summarized the position of geoscience education worldwide. Currently it is a small, compulsory part of national science and geography curricula and may be available as additional or optional courses. However, Earth and space science subjects are frequently offered to students who are 'unmotivated and unable to do "real" science like chemistry and physics' (Lewis, 2008, p. 446). With the exception of Japan, Korea and Taiwan (p. 189), geoscience is largely taught by out-of-field

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