Thematic Analysis of Qualitative Data Using Diverse yet Complementary Approaches

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This paper explores two different but complementary methods of thematic analysis to code interview data and survey questionnaire responses. The first approach represents the traditional 'by hand' identification of common themes. The second approach utilises the software tool QSR NVivo. The strength of this as a process lies in the triangulation of the two methods, providing enhanced identification and validation of the emerging significant themes.

Introduction

The collaboration between the University of Melbourne and Deakin University (ReMSTEP partners) and Museum Victoria, enabled the development of the Reconceptualising Rocks Project. The aims of the project were to provide an authentic learning experience for pre-service teachers, with Science specialisation, to connect to scientists and contemporary science and museum pedagogy practices, while also improving their competence in the teaching of Earth Science.

The following research questions were addressed by the team in its evaluation of the impact of the project and its alignment to the relevant ReMSTEP outcomes.

In what ways does the project enhance pre-service teachers' perceptions of Earth Science and the way in which Earth Science might be taught in schools?

How does the collaboration between Museum Victoria and pre-service teachers translate science ideas and practices for educational purposes in Earth Science?

The Learning Experience Model used in the Reconceptualising Rocks Project is presented in Figure 1 on the following page.

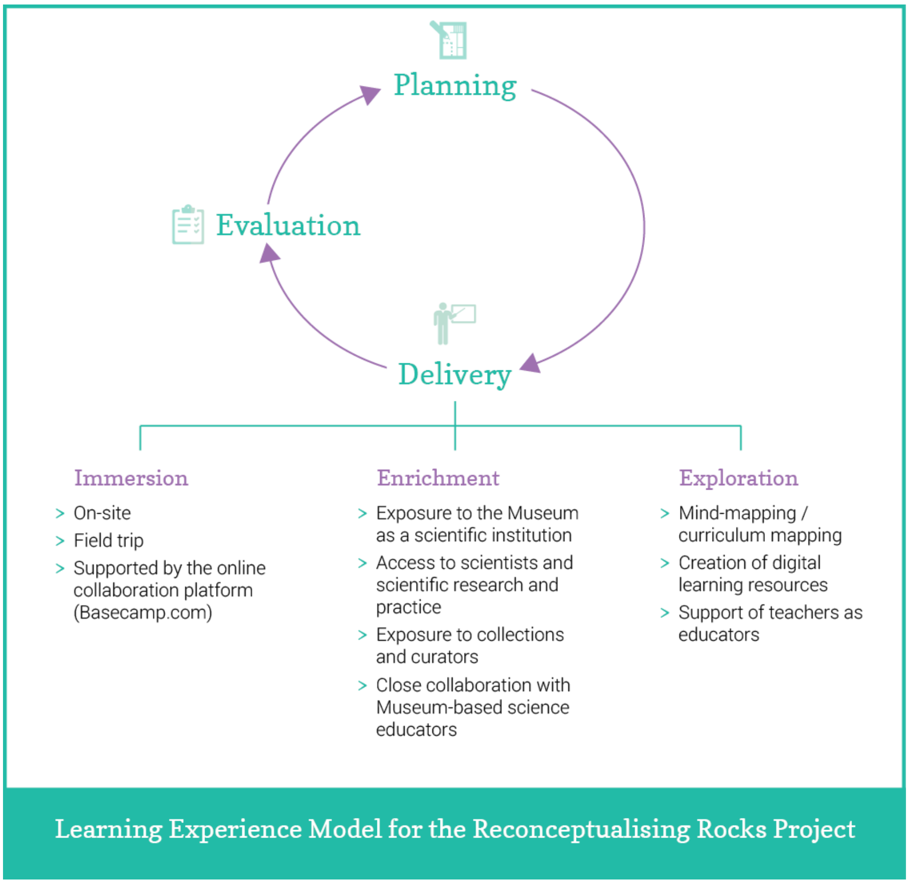


Figure 1: Learning Experience Model

Project planning and delivery

Links to AusVELS and the Australian Curriculum Science Strands: Science Understanding (SU), Science as a Human Endeavour (SHE) and Science Inquiry Skills (SIS) were considered in the planning of the project.

The focus of the project was an exploration of the pedagogical approaches of teaching Earth Science, rather than on delivering content knowledge. Nine pre-service teachers from the University of Melbourne and eight undergraduate Bachelor of Science students from Deakin University spent two full days at Museum Victoria, followed by a field trip to Phillip Island where they were immersed in the practical and evolutionary aspects of the formation and classification of rocks.

Project feedback and evaluation

In order to evaluate the impact of the Reconceptualising Rocks Project, feedback and reflections from the participants and the project team were required to provide evidence of the effect of the project on pre-service teachers' understanding of scientific practices in Earth Science. These goals align with ReMSTEP Outcomes 1 and 3 (Appendix 1).

Data collection

To investigate the ways the Reconceptualising Rocks Project enhanced pre-service teachers' perceptions of Earth Science and the way the support provided by the staff at Museum Victoria translated science ideas and practice for teaching in schools, a variety of research instruments were used. These included a survey which was given to pre-service teachers after the field trip to Phillip Island. The survey questions are presented in Appendix 2.

During the field trip, a member of the project team conducted a focus group discussion with 15 students from Deakin University and the University of Melbourne. Appendix 3 presents the questions asked during the discussion. The focus group discussion was video recorded and later transcribed in preparation for analysis. The duration of the discussion was 20 minutes.

Three interviews were conducted at each of Deakin University, the University of Melbourne and Museum Victoria at the conclusion of the project. The interviews varied between 20 and 54 minutes in length, were audiotaped and transcribed. The interview questions are presented in Appendix 4.

Thematic Analysis of Feedback Data

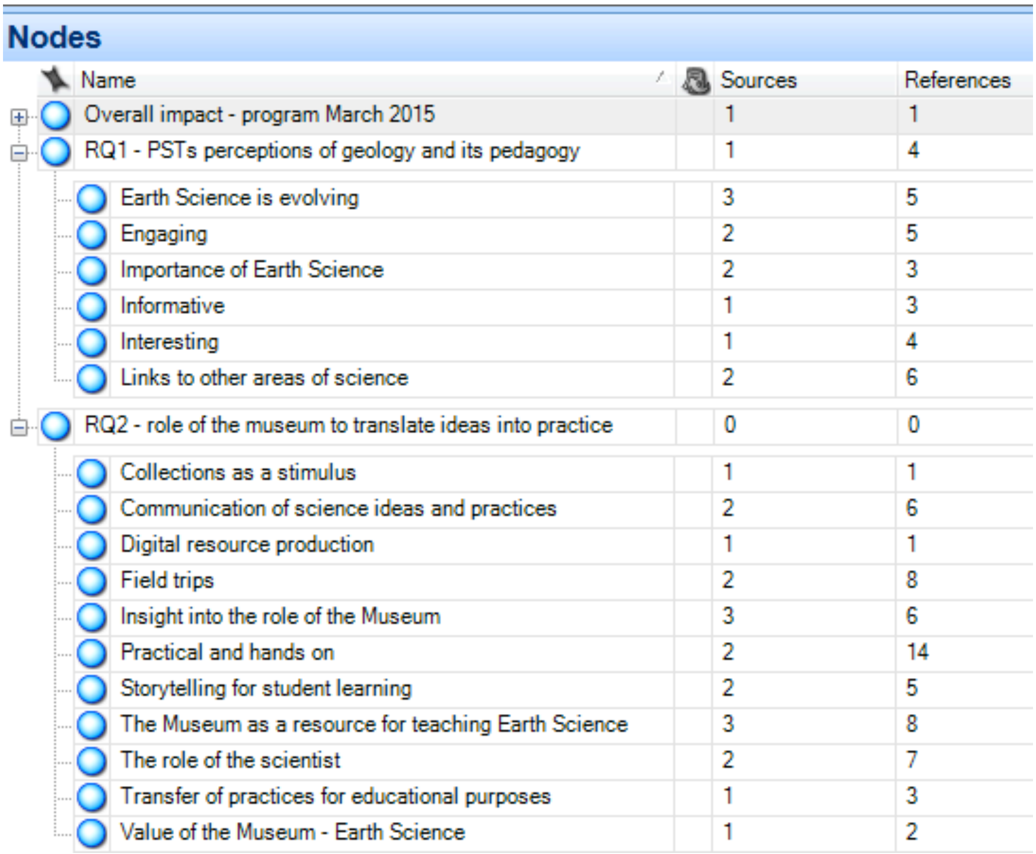
An inductive thematic approach was used to identify patterns and themes within the collected data. The themes emerged directly from the data, using two diverse yet complementary approaches. The analysis of the transcribed data was performed using manual coding and QSR NVivo. Both approaches enabled the voices of the participants to be heard; however, analysis using the manual approach involved placing the responses into the most appropriate category or categories. The approach using QSR NVivo placed responses in all applicable categories.

The major advantage of using QSR NVivo was its immediate and effective coding capacity and its ability to analyse multimedia sources. The search, query and visualisation tools of QSR NVivo provided an efficient method of determining the connections and patterns in the data and clarification of the context and identity of participant' responses.

The themes identified using manual coding are presented in Table 1. The initial coding nodes, determined using the QSR NVivo, are provided in Figure 2 on the following page.

Table 1
Themes identified from manual coding

Research Question 1 (RQ1)	Frequencies	Research Question 2 (RQ2)	Frequencies
Knowledge	1	Hands on	6
Informative	5	Field trip	11
Links Earth Science to other areas	9	The role of the scientist	12
Interesting	6	Practical	6
Earth Science is evolving	4	The role of the museum	4
Engaging	3	Different technologies	2
Important part of the curriculum	3	Collections	7
		Transfer of practices to school	3
		Digital resources	5
		Other aspects of Geology	3



Nodes

Name	Sources	References
Overall impact - program March 2015	1	1
RQ1 - PSTs perceptions of geology and its pedagogy	1	4
Earth Science is evolving	3	5
Engaging	2	5
Importance of Earth Science	2	3
Informative	1	3
Interesting	1	4
Links to other areas of science	2	6
RQ2 - role of the museum to translate ideas into practice	0	0
Collections as a stimulus	1	1
Communication of science ideas and practices	2	6
Digital resource production	1	1
Field trips	2	8
Insight into the role of the Museum	3	6
Practical and hands on	2	14
Storytelling for student learning	2	5
The Museum as a resource for teaching Earth Science	3	8
The role of the scientist	2	7
Transfer of practices for educational purposes	1	3
Value of the Museum - Earth Science	1	2

Figure 2: Node list identified from QSR NVivo
*(*Nodes = Themes and References = Frequencies)

Comparison of themes using the two methods of analysis

The difference in the frequencies relating to each theme resulted from hierarchical coding from the manual approach and inclusion of responses in all applicable categories in the approach using QSR NVivo. The emergent themes identified from the two approaches were compared and a definitive list containing overlapping and most frequently cited responses was compiled. The QSR NVivo software enabled effective checking of the context of responses and their relevance to the final list of themes. These are presented in Table 2 below.

Table 2
Final themes arising from the two approaches

Research Question 1 (RQ1)	Research Question 2 (RQ2)
Interesting and engaging	Practical and hands-on
Links to other areas of science	Insight into the role of the museum and as a resource
Earth Science is evolving	Communication of science ideas and practices
The importance of Earth Science	Field trips
	Transfer of practices for educational purposes

Outcomes

The two perspectives allowed for a triangulation of the data and validation of the emerging significant themes. The rigour of the manual method used in both approaches to identify the themes, combined with the flexibility of the software enabled the voices of the participants to be heard and efficient location and identification of individual responses.

References

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Appendices

Appendix 1

ReMSTEP Outcomes

1. Evidence-based development of approaches to mathematics and science education and teacher education that link contemporary practices in the sciences to evidence-based, inquiry-based, problem solving pedagogies consistent with contemporary thinking represented by the AITSL standards.
2. Improved visibility of teaching as a career option for high calibre science students, active promotion of postgraduate teacher education programs to these students, and improved support structures for these students as they progress through their course and into teaching full-time.
3. A cohort of graduate primary and secondary teachers better-equipped to integrate not just an awareness of contemporary mathematics and science concepts but aspects of actual mathematical and scientific practice into their classroom pedagogy.
4. Comprehensively documented innovative pedagogies that are specific to the education and communication of cutting edge mathematical and scientific practices, implemented across a variety of education contexts and sites.
5. Re-conceptualised units of study and science and mathematics educational activities that exemplify scientific practices, together with an evidence-based framework supported by public access resources to support collaborative work between specialist mathematics and science teacher educators and research mathematicians and scientists. Units and pedagogies will reflect the contemporary cross-disciplinary practices of scientific and mathematical knowledge generation and will align AITSL standards. It is anticipated that these will be made widely available through a web-mediated environment.
6. Innovative and effective teacher education practices that can be articulated and disseminated as exemplifications of meaning collaboration between the mathematics and science research communities and educators.
7. Key principles around which effective dissemination of these approaches can inform practice of other universities in connecting the sciences and teacher education together with communication principles and practices that can support public understanding of contemporary scientific practices and ideas.
8. An established network of science, mathematics and education researchers, supported with an online environment, dedicated to connecting contemporary science and mathematics and associated pedagogies in a variety of educational contexts (including low SES, high NESB, rural, remote, indigenous).

Appendix 2
Survey Questions

1	What expectations did you have of this project before you commenced it?
2	What were the major differences between your expectations of the project and the reality?
3	How have your perceptions of the relevance of Earth Science in the secondary science curriculum changed through your participation in this project?
4	What elements of the project do you believe have contributed to your capacity to provide quality Earth Science education?

Appendix 3
Focus Group Questions

1	What understandings do you now have, that you didn't have before, about the role of scientists in the museum and the role of the museum to support contemporary science?
2	What scientific practices carried out in the Museum have you learnt about that surprised or impressed you?
3	How has working with scientists from the Museum shifted your understanding of science and/or learning?
4	Has your understanding of contemporary Earth Sciences changed as a result of this project? If so, how?
5	How have your perceptions of the relevance of Earth Science in the secondary science curriculum changed through your participation in this project?
6	Would the process of the development and production of the digital learning resource be applicable in the classroom situation? Would you use this process in your own teaching?
7	What kinds of support and access to resources would you need in order to teach this topic?

Appendix 4
Team Interview Questions

Project's impact on students' knowledge, skills and attitudes, including pedagogical expertise	
1	What are your overall impressions of the project?
2	Were your expectations aligned with the project's outcomes?
3	In what ways the collaboration with the project team useful for you and the pre-service teachers?
4	Could pre-service teachers have achieved the same outcome without taking part in this project?
5	What was the most valuable aspect of the project for you and the pre-service teachers?
The role of the museum	
1	What understandings do you now have, that you didn't have before, about the role of scientists in the museum and the role of the Museum to support contemporary science?

2	What scientific practices carried out at the Museum surprised or impressed you?
3	What insights have you gained from this project in relation to translating contemporary science ideas for educational purposes?
4	What could secondary school students learn about contemporary science practices through visiting the Museum?

Acknowledgements

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